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New Function for Big Business

IN closing the case for the defense in the suit of the Government against the United States Steel Corporation, John G. Johnson pointed out a new rôle for big business that he urged upon the court as an additional reason against dissolution. Only the large corporation, in his opinion, will be in a position to hold its own in the war for world trade which is certain to follow the present European conflict. Dismembered, the component companies would be as pigmies against the might of German corporations, drawn together and made formidable by co-operation of the empire's businesslike government. It is hardly to be expected that the court will be in the least influenced by the argument. Its importance, however, will be more generally recognized at present than in normal times, for never before has the country at large been so much interested in the possibilities of foreign trade expansion.

Highway Improvements in the South

IN Atlanta next week highway engineers from all parts of the country will assemble at the American Road Congress. With the gathering in a Southern city it is natural to ask what the South has been doing in the countrywide campaign for better roads. The Engineering Record is fortunate in having Captain P. St. J. Wilson, assistant director of the U. S. Office of Public Roads, answer this inquiry in the leading article of this issue. To anyone who reads the article, "Progress of Highway Improvements and Finance in the Southern States," it will be apparent that the South has not been idle, for conditions have been revolutionized during the last 15 years by local bond issues, the general use of convict labor, and the granting of State aid in money and supervision. By comparison with the record of former years, it is shown that the total road and bridge expenditures, as well as the improved mileage, have increased over 300 per cent in 15 years. With this material progress there has grown a demand for the proper safeguarding of the expenditure of road funds and more efficient systems of road management in the South. The employment of skilled engineering supervision is becoming quite general in all the States. Captain Wilson does not deal in generalities. After discussing the problem of the Southern States in its larger aspects, he takes up the cases of the States individually and shows what each has accomplished. Local conditions have favored the South. The cost of labor has been low and the extensive use of sand-clay or gravel construction has enabled the States to reap a more widely distributed benefit for expenditures than any other section of the Union.

A Unique City Improvement

ON Thursday of last week the Mayor of Baltimore diverted the flow of Jones Falls, a small meandering stream running through the heart of Baltimore, into a tunnel built in conjunction with what is known as the Fallsway, thus forever burying an old open sewer, which has been an eyesore to the city. The remarkable feature of the improvement is that though it cost two million dollars and is for general public use, and not for a restricted measured service that can be charged for, it will eventually cost the city nothing. The increased taxes derived by the city from the creation over the stream of a new north and south street, running from the heart of the business district to the railroad depots, affording a traffic artery on easy grades, will pay the interest on bonds necessary for its construction and create a sinking fund to redeem them. The back lots of the properties backing on the old stream have been converted into valuable, desirable lots for business purposes facing this broad new boulevard. The work is a marked tribute to the man who conceived it, Calvin W. Hendrick, and is suggestive of possibilities in other cities. Had the stream been a wide one, with good water depth throughout the year, the improvement of its shores for shipping or for recreational purposes would have been advisable. Jones Falls, however, had a depth of water only in the spring, and for the rest of the year was a series of puddles. Under these conditions its conversion into a highway beneath which are three channels for carrying the flow was a most happy solution for ridding the town of a physical deformity.

Trade with Germany

NO one expects normal conditions in foreign trade until the European conflict is terminated. Nevertheless, the announcements made with respect to the resumption of trade with Germany last week give promise that more and more ocean carriers can be kept busy with non-contraband goods. Great Britain has formally declared that cotton shipped in vessels of neutral nations will not be interfered with, thus making it possible to supply the German demand, which, according to Ambassador Gerard, amounts to 50,000 bales per month. Austria can take 25,000 bales. Dye stuffs, potash, cyanide, drugs, chemicals and sugar-beet seed, which, except the last, were under embargo in the early part of the war, can now be freely exported from Germany, so that these products are available with which to maintain the trade balance. There is no reason why American vessels should not make the ports of Bremen and Hamburg, though this Government is urging that Rotterdam be used, since large amounts of drugs and chemicals from Germany are there ready for shipment. The favorable effect of the resumption of this trade is self-evident. Not only will it relieve the industries which have suffered from the lack of German chemicals, or are in danger of suffering, but it will help the distressing situation obtaining in the South. The Government is using all its efforts to encourage American ship owners to enter their vessels in this trade. It is hoped that its efforts will be successful.

Improving Public Works Reports

IF engineers will take to heart the suggestions offered in an article by A. N. Johnson, of the Bureau of Municipal Research of New York City, on page 519, there will be a marked improvement in the character of public-works reports. Mr. Johnson discusses some of the more common faults to be found in these documents and suggests measures for making reports better, both in the character and method of presentation of data and in typographical appearance. The advice is particularly timely, for it comes at a season when engineering department heads are beginning to think about their annual reports for 1914. There is ample time now to begin work along the lines suggested, and it will be to the interest of engineers generally to study the article and adapt its precepts to their own work. The trouble with most public-works reports is that those who prepare them do not know how to make effective use of the information at their disposal. Often page after page is filled with such dry information as the location of hydrants on street corners. This information, of course, is vital in any set of municipal records, but its place is in the files of the city engineer or waterworks superintendent and not in a report which is issued to the public at large. As Mr. Johnson points out, the supply of reports is limited in number and the information they contain cannot be disseminated to the best advantage by means of the reports themselves. Co-operation must be sought from the newspapers and from the technical press to secure the desired publicity. But this co-operation is rendered ineffective unless the report contains a general summary of the year's work, omitting dry, tiresome details, to which so much space is now given, and presenting the results in the form of a readable retrospect. One thing Mr. Johnson does not refer to, but which may well be emphasized, is the element of timeliness. It is not at all unusual, for example, to have an annual report for 1912 appear during the year 1914. The engineer, as a rule, has very little appreciation of the news value of information, but when his report is issued a year or two late he should not expect it to create any particular interest except as an antique. This negligence on the part of those who write reports is responsible for the burying of a great deal of useful information, which, if it appeared on time, would enjoy a very wide circulation.

Thin Base for Concrete Roads

WHILE highway engineers will find many items of interest in Austin B. Fletcher's account, on page 520, of how California is building its $18,000,000 system of State roads, attention will be focused more particularly upon his statement that the experience of two years has shown the suitability of the pavement consisting of a 4-in. concrete base with a thin bituminous top. While heavier bases are used where necessary, even under extreme traffic there have been no failures with the 4-in. section. The solution of the road problem in California was made difficult because, with the amount of money available, the State highway commission was called upon to construct 3000 mi. of modern highways at a cost averaging $6000 per mile. Obviously the completion of a program such as this necessitated the most rigid economies and the question resolved itself into a choice of three types of pavements—oil-macadam built by the penetration method, concrete with thin bituminous wearing surface and concrete with thick top of asphaltic concrete. Most of the construction is of the two latter types. While the use of so thin a base is not without precedent it should be selected only for ideal conditions—where the subgrade is firm and where there is no possibility of damage by frost. With these limitations it is to be inferred that the thin concrete base with its bituminous top, which has found such favor in California, would not meet with similar success in the East with its wide range of temperature. Climatic conditions in California also are accountable for the omission of expansion joints. While small cracks do develop, the bituminous covering fills them up, and apparently no trouble is caused. Good pavements are a matter, first, of good materials and then of good workmanship and it is notable that the California commission purchases its own cement and native asphaltic oil. Thus the commission controls absolutely the quality of its most important materials.

Is Railway Regulation Succeeding?

FOLLOWING closely after the radical proposal of President Ripley, of the Santa Fé system, discussed elsewhere in these columns, for Government directors of railroads and Government guarantee of a minimum return, comes an open letter from Charles Francis Adams to President Wilson. Mr. Adams is specially qualified to speak on the subject. Aside from being president of the Union Pacific Railroad from 1884 to 1890, he was before that one of the pioneers in railroad regulation, having much to do with the origin and development of the Massachusetts Railroad Commission. In his letter, however, he admits that "he had little realizing sense of what was finally to result from the movement then initiated," and that he "still questions in many repects its wisdom or its practical results." While his special concern is with conditions in eastern Massachusetts, he thinks that the present situation at large is not fully appreciated, that the elements of danger involved are far more considerable than is commonly supposed and that no effort at once intelligent and comprehensive is being made to deal with the matter. This journal can do no better than to quote his summing up of the situation: "Here is the largest investment and active business management of the country, and those managing it control neither outgo nor income. They are told what they must do and pay, and have no voice in what they are to charge. Such a situation is economically unheard of, absurd. It needs only to be stated. It is financially impossible of long continuance." That is the case in a nutshell, and it matters little whether the railroads have done all that could be done in the way of efficiency measures. The question involved in these rate cases is not whether the railroads shall be allowed to collect an additional amount, entirely inadequate measured directly, but whether the Government, by allowing the increase, will show a dawning recognition of the condition Mr. Adams describes and a disposition to remedy it. This would be a start toward the restoration of railroad credit. Meanwhile the problem of development for better and more economical service has been set aside because of the difficulty of providing funds even for proper maintenance, and, in the opinion of Mr. Adams, the very safety of the traveling public is fast becoming endangered. Perhaps this will strike home to those who fail to see any connection between general business prosperity and that of the greatest buyers—the railroads.

Progress in Street Lighting

THE struggle between the arc lamp and the incandescent for supremacy in the street lighting field resembles in some respects the perennial conflict between armor plate and projectiles. First one and then the other appears to have the advantage. The latest report from the front indicates that the arc lamp in the form of improved magnetite equipment has given even the gas-filled incandescent a severe shock on the score of efficiency. Designing engineers have been quietly working out improvements in electrodes which have added 50 per cent to the useful light and by the adaptation of the principle of the truncated prismatic reflector to the lamp, the distribution of the luminous flux has been spread over a broader area than ever before, so that the maximum illumination along the most useful line—ten degrees below the horizontal—is now approximately double the mean hemispherical candle power. Expressing the gain in another way, the latest arc lamp, fully equipped and in battle trim delivers a mean spherical candle power of from about three-fifths to three-quarters of a watt, including the losses in the mechanism, while four-fifths of a watt is close to the best that the gas-filled incandescent can do per mean spherical candle power, and this is likely to run well toward nine-tenths of a watt if the loss in the lamp transformer is taken into account. This peaceful warfare between illuminants is first-class evidence of the healthy condition of the electrical art, and it is good news to municipal engineers no less than to central stations that the efficiencies gained in the shop can be translated to the street without difficulty and at comparatively low cost. Out of such gains are likely to come new ideas in lamp spacing and revised costs for the lighting of thoroughfares of various types. The advance secured illustrates the benefits of co-operation between chemical research and what might be called engineering physics.

Function of the American Road Congress

NEXT week the American Road Congress convenes in Atlanta for its fourth annual meeting. Prospects, despite the depressed business conditions, are for a large attendance. This congress differs so widely from most of those in which civil engineers and contractors are usually interested that some comment upon its scope and purpose is in order.

Normally, conventions or congresses attended by civil engineers and contractors devote their time exclusively to engineering and construction problems. These, however, form but part—though an important part—of the program prepared for the Atlanta meeting. Legal, financial, administrative and educational problems connected with the extension of highway systems are to be given much time. The reason is that the highway problem long since ceased to be a strictly engineering problem. While it is true that much is still to be learned as to the proper types of surfacing for different traffic conditions and different sections of the country, while American inventive genius is to be expected to reduce still further the cost of construction, the road question has become a national issue destined to play an important part in our economic life.

The automobile is credited as being the stimulus for the present popular movement for an extension of good-roads systems. Doubtless it deserves much of the credit, but certainly the farmer has been awakened to the need for better highways, and, even without the automobile, would probably ere this have been responsible for a very considerable amount of road-improvement legislation. Even now he is credited with being an important factor in the movement, and those who are interested in highway propaganda are careful to be supplied with arguments that will appeal to him and secure his support for bond-issue and other legislation.

Interstate roads, too, are forcing attention to another phase of the road question—as to the differences between the laws of various States. Again, contact between State authorities has revealed much better methods of procedure in some States than in others, so that an inquiry seems justified as to those fundamentals necessary in any competent method of highway administration. The automobilists here again have been a factor, for their desire to have through routes from State to State has emphasized the differences in the legal status of highway work even in adjoining States.

Then, again, the establishment of numerous highway commissions with a variety of methods has raised questions as to procedure upon which many are seeking light.

These circumstances indicate how wide the field has become. The farmer, the lawyer, the automobilist, the State and municipal official must all be brought into the movement if procedure and methods are to be developed which will serve the country to the best advantage. It is for the purpose of bringing these classes together that the American Road Congress was established. How well it is fulfilling its function was evidenced by the very successful meeting at Detroit last year. Engineers should welcome an opportunity to become familiar with the wider phases of the work, for more and more they are being raised to the administrative positions and are relied upon to formulate the new State laws which are being passed almost yearly.

Engineers and contractors, moreover, need to appreciate fully that the greatest highway task in the near future is that of popular education. The public generally must come to a knowledge of what is essential in highway construction. This means that the fundamentals of drainage and dragging must be widely accepted, for, probably for all time, the earth road and its near brothers must constitute the greater part of the mileage of the country. As to hard-surfaced roads, the need for maintenance must be preached constantly, and with this preaching must go the conception of the true cost of surfacing—not the mere first cost but the whole cost over a period of years. In other words, maintenance and life must become familiar terms to those who vote the moneys with which highways are constructed.

Bearing this need for widespread education in highway matters in mind engineers will the more energetically participate in those proceedings at Atlanta far removed, apparently at least, from their immediate professional activities. Without highway funds, without legal restrictions, without, above all, a popular intelligence which will not only demand good roads but the best types of construction under the given conditions, there would not be any highway construction. Meetings such as that at Atlanta should do much to guide thought into proper channels and make sure that the education of the public in highway matters is being directed along the right lines.

Departmental Journals

IN an editorial in the Engineering Record of Oct. 3 the value of departmental journals, such as the "Reclamation Record" and the "Catskill Aqueduct News," was commented upon. The power possessed by such publications to weld the organization together was pointed out. Most journals of this class are elaborate publications, well printed and running to as many as twenty-five pages per issue. Manifestly such a pretentious journal is not possible for the small organization, but it must not be thought, therefore, that the idea cannot be applied to the small company or the small department.

The attention of the Engineering Record has recently been called to a number of mimeographed weekly bulletins which serve all of the purposes of the more elaborate publications. One of the bulletins circulates among the employees of the West Construction Company, of Chattanooga, Tenn. It bears the title, "The Wesco," the derivation of which is evident. Beneath the heading is this significant slogan: "Good work all the time—make money when we can." A foreword explains that the publication is devoted to happenings in the West Construction Company's organization and to general news about street paving work. The issue at hand contains but five sheets, legal size, but the material is such as to stimulate all members of the organization to greater effort. There is first a summary of the work performed during the preceding week on each of the contracts under way, with comparisons of the actual with the estimated cost per square yard. Where the actual costs are lower than the estimate or in excess, the men responsible are commended or constructive criticism offered respectively. For example, one of the comments runs as follows: "We all know the plant troubles we have been up against at —— and the excessive cost of this item cannot be attributed to the superintendent." Then follows news about each of the departments and the personnel—"snappy," and sometimes humorous, comment and incidents. In this way every man in the organization is kept in close touch with what the others are doing. He is encouraged by successes on other jobs and warned against mistakes by a frank discussion of the reason for unsatisfactory costs on others.

There is no doubt that construction companies generally, when jobs are scattered, can conduct such a little publication with great benefit to themselves. The cost is slight; the benefits immediate and gratifying.

Mr. Ripley's Proposal

PRESIDENT RIPLEY, of the Santa Fé—one of the "good" railroads—has made a suggestion as to a new method of solving the railroad problem, which among other things goes to show how desperate in his opinion is the plight of the carriers. Mr. Ripley proposes that the railroads be allowed to co-operate in groups, established on somewhat the same lines as the regional reserve banks; each group to have a single board on which there should be Government representatives with the power of absolute veto upon any act considered disastrous to the community or otherwise improper. The consideration for this representation would be a Government guarantee that future net earnings should not be less than the average for the last five years and that the roads should earn 6 per cent on additions and betterments made with the consent of the Government board members.

It is not expected that the Federal Government can or will give such guarantees. Nor is it certain that the scheme would work for the common good. Therefore, one cannot enthusiastically agree with Mr. Ripley that, "This system would give us all the admitted benefits of common control . . . all the economies incident to common ownership, and, at the same time, protect the rights of the public. It would do away with the enormous wastes of the competitive system and permit business to follow the line of least resistance."

The present system, under which private individuals furnish railway capital "while a group of lawyers at Washington provide a management of their own theories," is certainly attended with some very undesirable consequences. The competition forced upon the railroads results in tremendous waste. All railroads are in what Mr. Ripley calls a straight-jacket, and if one believes that the case is as bad as Mr. Ripley puts it, no suggestion, whatever difficulties it involves, should be passed by, for some way out of present conditions must be found.

As instances of waste, Mr. Ripley cites the fact that five trains leave Chicago nightly for Kansas City, six for Omaha and five for St. Paul, while two trains at most could carry the traffic to each of the three points named. Similar conditions prevail in other sections, and these, while striking, are not by any means the whole story of wastes that are forced upon the railroads.

More and more the public is coming to see that the straight-jacketing of the carriers is having a disastrous effect, not only on them, but upon all of us. The steel dividend would not have been cut last week if the railroads had been in a position to buy either before or after the war began. Next to the steel and iron industry—or perhaps equally with it—construction work, material and apparatus are most severely affected by railroad poverty. The whole country is affected in a lesser degree.

Is the country satisfied with the Interstate Commerce Commission and with the conditions brought about by it or which have arisen under the régime of regulation which has been extended until now practically all the powers of management have been taken away from the railroads and lodged with the commission? It makes rates, says what the service shall be, how railroad capital shall be obtained, and if obtained, what shall be done with it. Is this policy as judged by present conditions and results a success? If it is not it is time to look into it and to listen to Mr. Ripley or to anyone else who has another policy to propose, for we must agree with him when he says that the present trend of railway affairs cannot go on with promise of safety or satisfaction to the country at large.

The railroads, it is true, are reaping a harvest of their own sowing. The pendulum, however, has swung to the opposite extreme, and the only fear is that by the time a fair remedy is found there will be no solvent railroads to which to apply it.

Progress of Highway Improvement and Finance in the Southern States

Conditions Have Been Revolutionized During Last 15 Years by Local Bond Issues, General Use of Convicts for Road Work, and Granting of State Aid in Money and Supervision

By Captain P. ST. J. WILSON
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THE first extensive construction of improved roads in the Southern States took the form of toll roads, or turnpikes. As early as February, 1772, the Virginia House of Burgesses passed an act providing for the construction of a toll road from Warm Springs, Augusta County, to Jennings Gap. From 1787 to 1802, Baltimore County, Maryland, tried the experiment of constructing and operating toll roads as a county enterprise. At the end of that time the plan was abandoned. It is interesting to note that 112 years later, Augusta County, Virginia, is trying the same experiment, with apparent success.

EARLY FORMS OF STATE AID

Soon after the beginning of the nineteenth century the demand for the construction of toll roads exceeded the available capital, and the States, as well as many counties, subscribed to the construction of turnpike roads. Of the Southern States, Virginia, Kentucky, Maryland and Tennessee engaged in this early form of State aid. Virginia in an act authorizing the construction of a turnpike from Staunton to Winchester, and thence to Parkersburg on the Ohio River, agreed to pay three-fifths of the cost. The 92 mi. from Staunton to Winchester were finally completed as a substantial Telford macadam in 1838, at a total cost of $465,000. This road is still operated as a toll road, with but slight modification of the original charter.

Between 1820 and 1838 Kentucky invested $2,509,473 of State funds in turnpikes, and about $250,000 in aid to the opening of free roads. At the height of the toll road period Kentucky had about 1,000 mi. of improved turnpike roads. Maryland never engaged so extensively in State aid to the turnpikes. In 1818, when the total investment in turnpike roads represented a sum of $2,100,000, the State had only invested $15,000. Today, only Virginia maintains any large mileage of toll roads. The old turnpikes have passed out of existence, either by the expiration of their charters or their purchase by the State or counties and opening as free roads.

Highway conditions in the South have been practically revolutionized during the last 15 yr. through local bond issues, the general use of convicts for road work, and the granting of State aid in money and supervision. A decade and a half ago only one Southern State, Maryland, had made even a beginning looking toward State participation in road building. At that time, the chief source of road revenue was the always inefficient statute labor. Exact data are lacking, but it is not believed that the improved mileage of the sixteen States, usually classed as Southern, at that time exceeded 2 per cent of a total of about 775,000 mi., or 15,500 mi. surfaced with sand-clay or better, while the annual road and bridge expenditure probably did not exceed $15,000,000.

On Jan. 1, 1914, the best available data give these States a total mileage of 855,559 mi., of which 51,981 mi., or 6.08 per cent are improved. The total expenditure during 1913 approximated $50,000,000 of which $20,000,000 was raised by local bond issues. The total road and bridge expenditures as well as the improved mileage have, therefore, increased over 300 per cent in 15 yr., which compares very favorably with the progress of the United States as a whole in road improvement, and because of certain favorable local conditions, the chief of which are low cost of labor, and the extensive use of sand-clay or gravel construction, the South has reaped more widely distributed benefits for expenditures than any other large section of the United States.

The successful utilization of convict labor, both State and county, has also played a large part in road betterment. In Georgia, practically all of the able-bodied male convicts are employed on the roads in the various counties. This gives a permanent force of about 5,500 men, a large portion of which become efficient road workers.

North and South Carolina also utilize most of their county convicts on the roads. In North Carolina the State convicts with less than 10-yr. terms are also employed on the roads. West Virginia has recently made provision for the employment of both county and State convicts in road work.

For general maintenance and repair work all the Southern States, except Maryland, Virginia and West Virginia, rely to a large extent on statute labor. The necessary local cash road and bridge revenues are levied as direct taxes.

FINANCING ROAD IMPROVEMENTS

The financing of road improvements by local bond issues is very general in the South and shows a striking increase in recent years. In 1904 the total of all road and bridge bonds voted in the Southern States amounted to only about $1,250,000. This amount was exceeded in each of eight of the Southern States in 1913, while the total road and bridge bonds voted in the sixteen Southern States in 1913 amounted to $23,397,199, or about nineteen times the 1904 total. The bonds voted in 1913 exceeded the entire expenditure for roads in the South in 1904. Of the individual States Texas is first with $6,598,819 of bonds voted in 1913; North Carolina second, with $3,642,500; Tennessee third, with $2,766,000; and Florida fourth, with $2,665,000. All available data indicate that this year will exceed 1913 in the amount of road and bridge bond issues. For example, in Texas the road and bridge bonds voted the first six months of 1914 amount to $6,581,500, or nearly equal to the total voted in 1913. The largest single bond issue voted this year, so far as reported, was $1,075,000 in McLennan County, Texas. These large expenditures emphasize the importance which road improvement in the South has attained in the past few years.

The demand for the proper safeguarding of the expenditure of the road funds and more efficient systems of road management is steadily growing. In Virginia, the expenditure of bond issues is required by law to be supervised by the State highway department. This plan has had most satisfactory results. A recent law in Mississippi requires that county bond issues be expended under skilled engineering supervision. Tennessee by law requires that an annual sum equal to 2 per cent of the original bond issues be raised by taxation for the sole purpose of maintaining the road constructed from the bond issues. The employment of skilled engineering supervision is becoming quite general in all the States. The public has become convinced that such supervision is not only a necessary safeguard, but a paying investment.

STATE AID IN MARYLAND

Maryland was the pioneer State of the South to embark in State, as well as State aid construction. In 1898 the Legislature made an annual appropriation of $10,000 to the Maryland Geological and Economic Survey for educational and advisory work. This work was continued for a period of 6 yr. In 1904, $200,000 was appropriated as State aid to the counties in the construction of improved roads. In 1908, the Legislature adopted a definite system of 1,285 mi. of State roads, which were to be built and maintained entirely at the expense of the State. In 1910, the State highway commission was established as a separate department, in full charge of all the State and State aid road work. The State roads are built from the proceeds of State bonds, while State aid is voted from the general revenues of the State, and the annual income from the licensing of motor vehicles is utilized for road maintenance.

To Jan. 1, 1914, Maryland had voted $9,140,000 of bonds for the construction of State roads. Of this amount, $8,646,000 had been issued and sold. The 1914 Legislature voted a further appropriation of $6,600,000 in State bonds, of which $5,000,000 is to be expended in the construction of the system of State roads, and the remaining $1,600,000 for the construction of roads and bridges in Baltimore City. Appropriations for educational work and State aid on Jan. 1, 1914, had reached a grand total of $2,314,000, and resulted in the construction of 253 mi. of State aid roads, a portion of which have been included in the State road system. To date there have been constructed about 600 mi. of State roads.

In 1901 North Carolina made an appropriation of $2,500 annually to the State Geological and Economic Survey for educational work in the furtherance of better roads, and thus became the second Southern States to take definite steps for State activity, looking to the improvement of her public roads. But this preliminary step, while productive of much good and still continued with an annual appropriation of $5,000, has not yet resulted in actual State aid, except in the employment of certain State convicts by the counties.

IMPROVED ROADS IN VIRGINIA

Virginia was the second Southern State to establish a substantial and comprehensive system of State aid in the construction of improved roads. The law, passed in 1906, deserves especial mention as being the first to provide for the use of State convicts for road construction under State supervision.

During the fiscal year of 1913 there were constructed 192 mi. of road by convict labor, at a cost to the commonwealth of $144,378, the total cost to the counties and State aggregating $510,154. During the month of August, 1914, Virginia had 30 convict road camps, employing 1,536 convicts, or an average of 51 convicts to each camp.

The Virginia law now provides for either convict labor or money aid at the option of the county, both under the supervision of the State highway department. The State pays one-half and the county one-half of the cost of money aid roads. Biennial appropriations by the Legislature from the general fund are supplemented by the net revenue from the licensing of motor vehicles.

From the establishment of the State highway department in 1906 to Oct. 1, 1913, Virginia has expended a total of $1,663,317 in State aid and the maintenance of convict camps. The results from this expenditure are most gratifying, consisting of 664 mi. of macadam, 370 mi. of gravel, 723 mi. of sand-clay or top soil, 9 mi. of shell, and 285 mi. of graded earth road, or a total of 2,051 mi. of road improved in a little more than 7 yr. since the establishment of the State highway department.

The latest available mileage figures indicate that in the actual miles of road constructed under State supervision, with the aid of State money, Virginia ranks second. New York has by far the largest mileage of State and State aid roads, with a total of 4,304 mi. Michigan has a total of State reward roads of 2,344 mi., but it must be understood that under the Michigan reward plan the aid granted by the State forms a very small percentage of the total cost of the roads, and, furthermore, these roads are not constructed under State supervision. Eliminating Michigan from comparison, Virginia has a clear title to second place in mileage of State aid roads.

The New York department was established in 1898 and has been in existence twice as long as the Virginia department, so that the results accomplished by the latter compare favorably with even the New York work. The roads constructed in the State of New York are, in general, of a much higher class as to type and cost, but the Virginia roads are adapted to the traffic which they are required to sustain, and their low cost has enabled the department to meet the needs of the traffic in counties representing every section of the State.

The Virginia system, like most others, is weak through its failure to provide for adequate maintenance of the State aid and bond built roads. The folly of this neglect has been so strongly pointed out that the next Legislature will probably make provision to prevent the destruction of the roads which have been improved with State aid.

Alabama established a State highway department and inaugurated State aid to the counties in 1911. In 1913 only seven counties in the State failed to avail themselves of the State aid, which amounts to $2,000 annually to each county on condition that the county raise at least an equal sum, the whole amount to be expended under State supervision. During the years 1911 to 1913, inclusive, 227 mi. of improved roads were built under the supervision of the State highway department. The revenues for carrying on the State aid work are derived from the State convict fund. In this way, the State convicts are indirectly utilized for State aid to roads.

Under an act passed in 1910, Louisiana established a system of State aid to the several parishes, the State paying not to exceed one-half the cost. The administration of the road work is under the State board of engineers; a State highway engineer appointed by this board has active charge of the work. The revenue for State aid is derived from a ¼-mill State tax, and the surplus revenues from a number of State commissions. State convicts were at first used in road construction, but the more pressing demand for levee improvement and repair, caused them to be transferred to the levee work in 1912.

Kentucky established a State highway department in 1912. To the present time the work of the department has been limited largely to advisory and educational work. A bill passed by the last Legislature, however, established a State tax of 5 cents on $100 for State aid, which will be available next year. This will place Kentucky well toward the front in the way of State revenues for road construction.

West Virginia in 1909 passed a law providing for a State highway department and a State tax yielding about $120,000 a year for State aid, but before any considerable amount of work had been accomplished, the law was repealed in 1911. The Legislature in 1913 provided for a State road bureau at the State University, to be devoted chiefly to advisory and educational work. Provisions were also made for the employment of the State and county convict labor. Three State convict camps had been established on Sept. 1 of this year, and were giving good satisfaction.

"WAR FUND" IN MISSOURI

Missouri in 1907 provided for a State highway engineer under the State board of agriculture. His powers were, however, little more than advisory, and with little or no authority over the expenditure or distribution of State funds to the counties for road purposes. In 1907, the so-called "war fund," amounting to $475,000, was distributed to the various counties for road purposes, but without State supervision for their expenditure. From Jan. 1, 1907, to Jan. 1, 1914, there was distributed to the various counties for road purposes, the total sum of $1,146,730, most of which was expended by the counties, with little or no State supervision. This money was secured mainly from the previously mentioned "war fund," a stamp tax, and the licensing of motor vehicles. In 1913, a State Highway Department was established, but its powers are largely advisory.

Oklahoma established a State highway department in 1907, but its powers are limited to advisory and educational work. The same is true of Arkansas, which established a Department of State Lands, Highways and Improvements in 1913.

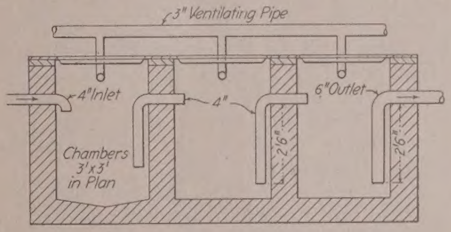
Georgia, as stated above, employs all male able-bodied convicts, county as well as State, on roads. This is resulting in the construction of a very large mileage each year. Georgia grants to the counties the labor of some 2,500 State convicts, which is supplemented by more than 3,000 county prisoners, but the State has no control over the work done by the convicts.

Florida distributes to the several counties for road purposes the income from the sale of certain State lands, but retains no supervision over the expenditure of these funds.

South Carolina, through the commissioner of agriculture, commerce and industry, collects and publishes road information and statistics, while in Tennessee the Governor has appointed a commission which is to collect information and is to make such recommendations as it finds necessary for the improvement of the roads of the State. Mississippi and Texas have, as yet, no central highway authority.

Triple Intercepting Catchbasins for Chicago Garages

DRAINS from public garages and plants where oil is used in Chicago are required to be protected by a triple intercepting catch basin as shown in the accompanying sketch which has been approved by the Bureau of Fire Prevention and Public Safety jointly with the Department of Health. All plans for garages and cleaning establishments must be submitted to the Fire Prevention Bureau for approval before being submitted to the health officials.



SECTION OF CHICAGO CATCHBASIN

For some time a regulation has been agreed upon between these two bodies which requires every newly constructed public garage to have the triple basins through which all sewage shall pass before entering a public sewer. If built inside buildings the basins shall be of metal with a minimum depth of 24 in. Each unit is to be tapped so as to allow a water seal of not less than 10 in., and is to be connected to a vent pipe of at least 2 in. in diameter. Not less than 4 in. of air space is to be left between the water line in the basin and the bottom of the vent. The inlet is to have not less than a 4-in. water seal. Over the basin is to be an air tight bolted cover. Sand basins emptying into this system are to be without traps. Downspouts must not be used for venting such basins.

STONE PRODUCTION in the United States in 1913 reached a value of $83,732,995, according to E. F. Burchard of the U. S. Geological Survey. This is an increase of 7 per cent over the record-breaking figures for 1912. The value of granite produced increased 8 per cent, that of trap rock nearly 23 per cent, sandstone 2 per cent, marble 1 per cent and limestone more than 5 per cent.

Utilizing Ore-Dock Pockets in Concrete Plant

Aggregate Delivered from Pockets to Base of Tower, Then Lifted to Mixer, Which Fed into Elevated Cars on Trucks

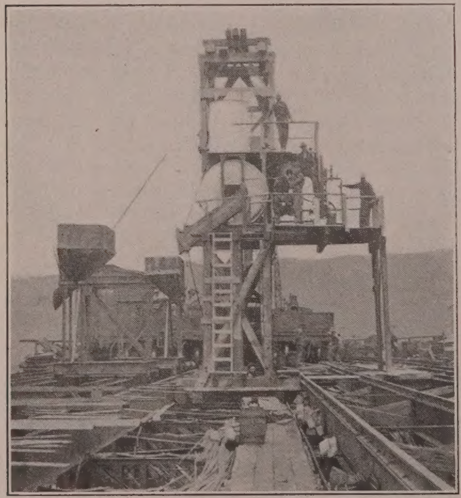
AFTER the lining of the first three ore pockets of the new ore dock 5 of the Duluth, Missabe & Northern Railway at Duluth was completed, the pockets were used to store the aggregates from which concrete for the remainder of the work was made. The work consisted of making concrete pocket bottoms, partition walls and a concrete deck for the dock, the foundations of which were described in the Engineering Record of Aug. 29, page 249. The dock has 192 double pockets each 12 ft. wide, about 34 ft. deep and holding 600 tons of iron ore. While the amount of concrete totals 17,200 cu. yd., reinforced with 55 tons of steel, the sections are all thin—the bottoms 9 in., the partitions 12 in., and the deck 8 in.; consequently the form work was considerable for the amount of concrete, and the area covered was so spread out that the daily output was much less than the concrete outfit could supply.

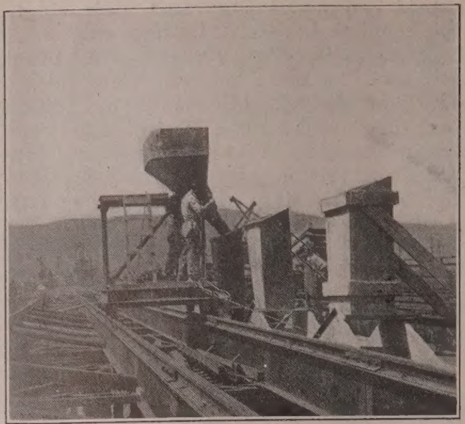
The concrete plant consisted of a 1-yd. Chain Belt mixer on a platform elevated 13 ft. above the deck, and a tower in the center of the dock rising from the foundation to the mixer. Sand and rock were delivered over the completed steelwork structure in bottom-dump ore cars which unloaded directly into the pockets first lined. Universal cement was delivered in bulk and shoveled into a third pocket under the mixer. Spouts with gates at the lower end led from the pockets to the bottom of the tower and discharged into a special Lakewood skip by which the material was elevated to the mixer. Sand and broken stone were proportioned by volume in the spouts and the cement was added by weight.

From the mixer the concrete was discharged into side dump hoppers mounted on standard-gage trucks on a steel frame at such an elevation that the deck and upper portions of the pockets were fully covered. An endless cable driven by a hoisting engine was used to transport these cars.

The average output for two months was 255 cu. yd. per 20-hr. day. The maximum run was 213 cu. yd. in 7 hr., although the superintendent states that twice this amount could have been made if the concrete could have been taken away.

Whitney Brothers, Stack & Company, of Duluth, with Lyle Clapper, as superintendent, had the contract for the concrete work, which was carried out under the general direction of H. L. Dresser, chief engineer of the Duluth, Missabe & Northern Railway.


ELEVATED MIXER PLANT ON ORE DOCK


SPOUT TO BASE OF CONCRETE TOWER

Appraising Abandoned Railroad Property

Suggestions from Presidents' Conference Committee as to Proper Way to Schedule It for Federal Valuation

VALUATION ORDER 2 of the Interstate Commerce Commission, dated May 12, requires each carrier, in connection with the Federal valuation, to file on or before Feb. 1, 1915, complete and detailed schedules of all fixed physical property abandoned prior to June 30, 1914, together with a complete and detailed statement of its claims with respect thereto. To aid in complying with the order the Presidents' Conference Committee, after careful consideration by its engineering committee, makes suggestions which are slightly condensed as follows:

A. It is clear that property which has been gradually consumed in the business of the carrier and replaced in ordinary maintenance should not be included in the list of abandoned property.

B. Property which is not now in use, but which is intended to be used in the future for the purposes of a common carrier, should not be included in the list of abandoned property, because such property is owned or used for the purposes of a common carrier and will be valued as such. The intention of the carrier is an important element in deciding what is and what is not abandoned property.

DETAILED STATEMENT REQUIRED

C. It is the desire of the commission that each carrier make a detailed statement of all its claims with respect to its abandoned property and the effect of such abandonment. Such statement should accompany the schedule and should specify the means by which the schedule may be verified and the original cost to date of abandonment of each item as well as the amounts claimed by reason of such abandonment. It is understood that the order does not require the preparation of new maps and profiles of abandoned property, but that the carrier should furnish a descriptive list of such as are in existence and other sources of information that will support its claim. It should be noted, however, that the commission may require the filing with it of the maps, profiles and other records to which the carrier refers.

D. The carriers may claim, and in the majority of cases probably should claim, that the actual cost of such fixed physical property to date of abandonment should be included in the original cost to date which the commission is required to ascertain and report, and if the fixed physical property which has been abandoned would be recreated in a reproduction of the railroad, that the estimated present cost of the same should be included in the cost of reproduction new required to be ascertained and reported.

FIXED PHYSICAL PROPERTY

E. Fixed physical property includes all property of that kind which has been abandoned, whether or not physical evidence of the existence of such property now remains. All such fixed physical property should be listed wherever evidence of the existence of such property can be found, whether in the records of the company or elsewhere.

F. Where a temporary track was constructed and used until the completion of a tunnel, and where other structures were built in aid of the construction of the railroad or to hasten its completion, even though permanently abandoned, the estimated present cost should be included in the cost of reproduction new of the railroad, and the actual cost should be included in the original cost to date of the road. However, in order to avoid the possibility of having the original cost and reproduction cost of property of this kind omitted by the commission, each carrier is advised to include all of the same with the cost thereof to the date of abandonment in the schedule of abandoned property with its claims in reference thereto fully stated, and in such case the inclusion will not prevent allowance therefor by the commission in original cost and cost of reproduction.

G. Loss resulting from the permanent abandonment for railroad purposes of right-of-way or other real estate should be included in the schedule, showing the original cost and the salvage value (which is its value for purposes other than those of a railroad) the difference between the two being the amount of the loss. When the title of the carrier became extinguished by the abandonment, there is, of course, no salvage and the amount of loss is the original cost.

In the class of cases first above mentioned, the loss resulting from the abandonment should be shown in the schedule and a statement of facts sufficient to identify the land and showing the circumstances of the transaction should be referred to and attached. In the class of cases last above mentioned a description of each such piece of land with the original cost of the same to date of abandonment may be shown in the schedule.

WHAT TO INCLUDE

H. The following items should not be included in the schedule of abandoned property:

(a) Hidden quantities, which are a component element of the present property, such as filled trestles, etc.

(b) Land still owned by the carrier.

(c) Structures temporarily out of service.

(d) Salvage value of rails and other materials that may have been removed from abandoned line.

The following items should be included:

THIRTY-CAR NARROW-GAGE TRAIN IN WAYNE COUNTY DEPOSITING 60 TONS OF CRUSHED STONE AT ROADSIDE

(a) Land, the title to which was lost through abandonment.

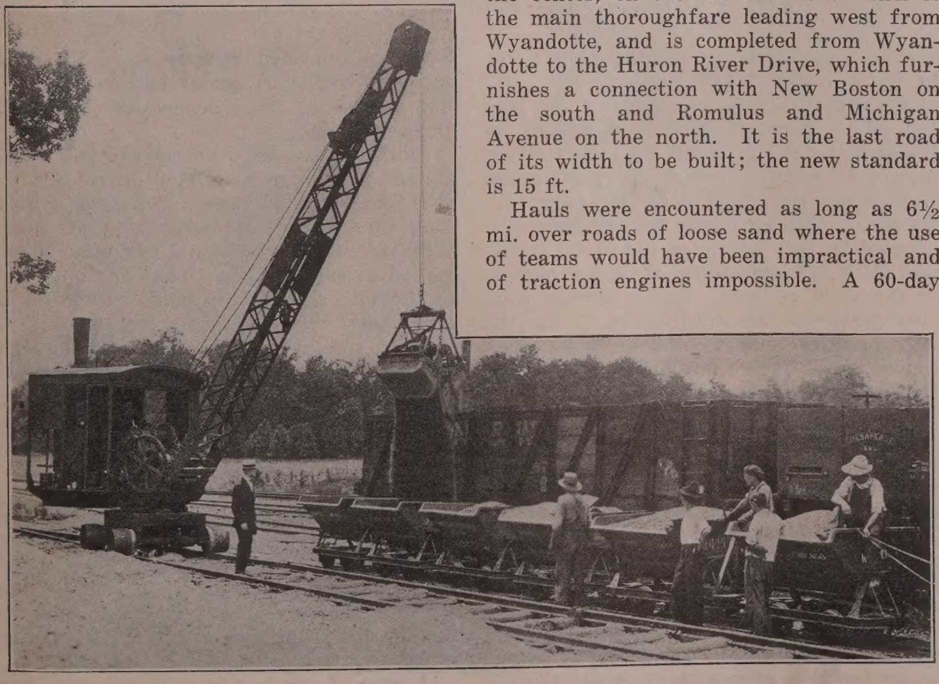
(b) Roadbed of an abandoned line.

(c) Terminal improvements which have been abandoned.

(d) Bridges on abandoned line, protection work, culverts and other structures, and the foundations and abutments of bridges on abandoned lines.

I. It is understood that the use to be made of the information called for has not yet been determined. It is plain that if the original cost to date of abandoned property be included as a part of the carriers' investment, a greater amount will be shown than the aggregate of original cost to date of the items of property now actually owned or used for railroad purposes. It is to be borne in mind, however, that the information contained in the schedules may be used by the commission as a basis for charging out of the investment in road and equipment appropriate amounts on account of such abandoned property in all cases where proper deductions have not heretofore been made in the records of the company.

FATALITIES IN ELEVATORS in the Borough of Manhattan, New York City, from 1907 to 1911 inclusive, have recently been analyzed by Frederick H. Dewey, acting superintendent of buildings. Eighty per cent of the 119 accidents in passenger elevators were shaftway accidents, which it is believed would probably have been avoided if satisfactory interlocking safety devices, which would prevent the car from leaving a platform so long as the door was open, had been used.



LOADING SMALL CARS AT RAILROAD SIDING WITH CLAMSHELL BUCKET

Railway Plant Used in Building Wayne County Roads

Small Locomotive and Cars Operated over Sticky Clay Soil Carried 28,000 Tons in Four Months for 10.5 Cents per Ton-Mile

SOIL consisting largely of heavy, sticky clay, with some loose, deep sand, has made transportation of materials the most serious problem confronting the Wayne County (Michigan) Board of Road Commissioners consisting of Edward N. Hines, William F. Butler and John S. Haggerty. An experience in 1914 with narrow-gage railway equipment, however, indicates a solution of this difficulty.

The county's hauling plant comprises the industrial equipment, eight traction outfits and from 100 to 150 teams. Teams work economically on short distances, it is said, but weather conditions at times are a handicap and at certain seasons of the year the general demand is so great that they are difficult to secure at practical terms. The traction outfits are also handicapped by bad roads, rainy weather and the limited speed which they are capable of attaining. Road rollers furnish the motive power largely for hauling wagons, each of which holds 7 tons of material. Over earth roads one wagon is usually all that can be drawn. When, however, a concrete road is available for hauling, six wagons containing a total of 41 tons of material are made up into a train and hauled by one 10-ton roller. The crew of one of these trains consists of an engineer and a fireman.

The efficiency of industrial plant was tested in laying 6½ mi. of 12-ft. concrete slabs, 6 in. thick at the sides and 8 in. at the center, on the Eureka road. This is the main thoroughfare leading west from Wyandotte, and is completed from Wyandotte to the Huron River Drive, which furnishes a connection with New Boston on the south and Romulus and Michigan Avenue on the north. It is the last road of its width to be built; the new standard is 15 ft.

Hauls were encountered as long as 6½ mi. over roads of loose sand where the use of teams would have been impractical and of traction engines impossible. A 60-day option was taken on an equipment consisting of sixty 1000-lb. 1½-yd. Koppel cars, five 16-ft. flat cars, about 35,000 ft. of steel track, switches and turnouts, and a 7-ton 30-hp locomotive, all of 2-ft. gage. Used on the Eureka road and the Huron River road, this outfit within four months hauled 27,512 tons of cement and aggregates over an average distance of 2.84 mi. at a cost of 10½ cents per ton-mile. At the end of two months the commissioners exercised their option and bought the plant.

OPERATION OF RAILWAY PLANT

The following details of operation are given by the commissioners: Materials begin to arrive before actual concreting is in progress. These are immediately unloaded by a clamshell bucket and thrown into stock piles. After concreting has begun the materials are unloaded directly from the railroad cars to the steel dump cars and transported to place. The unloading crew consists of four laborers, an engineer, one team and a teamster. The team hauls seven loaded cars to the siding, where trains of thirty cars are made up. Whenever shipments are delayed the stock piles are used.

Depositing is started at the end farthest away from the railroad switch. Five miles per hour is the average speed, including time for coaling and watering, and the actual running speed is 8 to 10 mi. Materials are measured in the cars and distributed along the road at the proper intervals. The aggregates are loaded into the dump cars, the cement in any available cars, and expansion plates, asphalt filler and other necessities on the flat cars. Coal for the mixer is likewise brought to the site over the railway. Two men are able to tip a loaded car body. As concreting progresses the haul becomes shorter and the rail sections are taken up and transported to the loading point on the return trips.

Emphasis is laid by the authorities on the fact that the tracks can be laid on any surface over which transportation of any kind is possible. Rainy weather and muddy roads have little effect on the efficiency of rail haulage, nor is the load too heavy for the ordinary highway bridge. Very little hauling space is required, and when necessary track can be laid on the berm of the road, so that material may be hauled either in the direction of concreting or opposite. The railway, too, is practically independent of labor conditions, as one engineer and one brakeman made up the entire crew. One difficulty has been encountered. Although the unit rail sections provide an easy method of crossing highways and steam and electric lines and the clearing of these when necessary by removing the rail sections, it is not always possible to obtain permission to make such crossings.

HAULING DATA

Cost and quantity data are given in the accompanying table. These were kept on

HAULING DATA FOR AGGREGATES AND CEMENT CARRIED BETWEEN MAY 23 AND SEPT. 23.

Disbursements:	
Unloading and laying track	$731.22
Operating	3,660.00
Depreciation (15 per cent) and repairs for one year	3,899.34
Total	$8,290.56
Materials handled:	
Eureka Road:	
Pebbles	12,530 tons
Sand	5,720 tons
Cement	3,060 tons
Total	21,310 tons
Huron River Drive:	
Pebbles	3,850 tons
Sand	1,716 tons
Cement	936 tons
Total	6,502 tons
Haul:	
Average... Eureka Road	3.25 mi.
Average... Huron River Drive	1.5 mi.
Work..... Eureka Road	69,257 ton-mi.
Work..... Huron River Drive	9,753 ton-mi.
Total	79,010 ton-mi.
Cost per ton-mile	10.5 cents

both Eureka road and Huron River drive jobs, and cover the period from the date of delivery, May 23 to Sept. 23. Allowance for overhead and office charges is included in each item.

These data are based upon the hauling of materials only, no account having been taken of armor plates, joint filler, empty cement sacks or the transportation of men from one point to another. The commissioners believe that, compared with other methods of haul applied to similar conditions, a saving of approximately the cost of the entire equipment has been effected.

This statement indicates that horse or motor haul would cost about 35 cents per ton-mile. It was originally intended to haul all materials as rapidly as possible by working a double shift, but the railroad was unable to give the necessary switches to make this feasible. Had it been possible to carry out the original plans, the plant would no doubt have hauled all the materials for these two jobs and been available for other work. As a result of the slow and irregular arrival of materials at this particular point, it was impossible to keep the equipment busy through a double shift and, in fact, at times through a 10-hr. day. This has made the depreciation charge bulk larger than it should. As the hauls are growing longer and the difficulties incident to working out an efficient method of operation are being eradicated, the commissioners expect next season to add to the economy already effected.

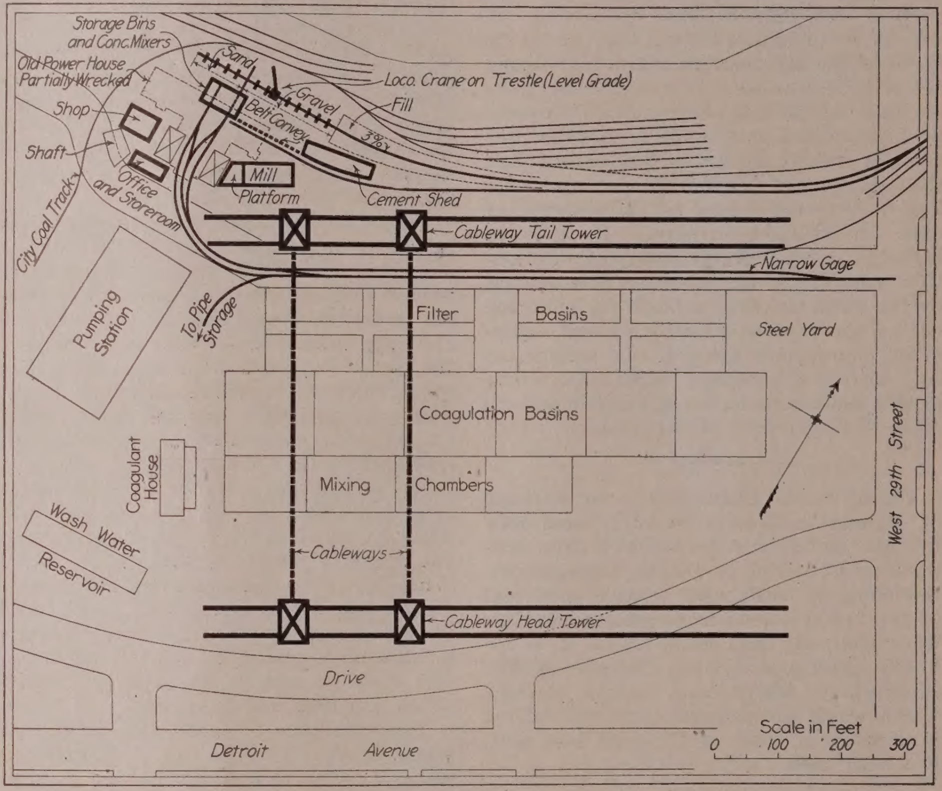
New Irrigation Meter

AN irrigation meter, based upon the dividing and subdividing of the flow of water over a weir until a quantity small enough to be measured in a graded measure is obtained has been invented in Canada. By dividing a total flow into ten equal parts, the tenth part being subdivided into ten equal parts, the hundredth part is obtained; only twenty outlets are required to get this fraction. By subdividing this part into ten, the thousandth part is obtained by the use of thirty outlets. By dividing and subdividing a flow six times in this manner a millionth part is obtained, sixty outlets being required. A meter for measuring discharges from pipes and flumes has also been built on this principle. A record under seal is furnished for the company and also one under lock and key. As each is set in separate compartments one can be used as a check on the other.

Construction Plant for Cleveland Filters

Elaborate Equipment Enables Contractor to Place 18,000 Cubic Yards of Concrete per Month, and Gain Five Months on Scheduled Time

CONVERTIBLE form sheets, plenty of equipment properly put in shape before starting actual construction, and an organization perfected on previous works, are points emphasized as contributing largely to the rapid progress made in constructing the Cleveland filtration plant. On Oct. 1, contract 1, calling for the concrete work of the mixing basins, coagulating basins and filters, described in the Engineering Record of June 6, 1914, page 651, was within 25 per cent of being completed. At this rate the end probably will be reached five months ahead of the fourteen months' time limit, expiring in July, 1915.



LAYOUT OF CONTRACTORS' PLANT AT THE CLEVELAND FILTERS

All material is brought in by rail and the mixer plant is located as shown on the drawing at the northwest corner of the site of the work. Two Lidgerwood cableways span the work. A connection between the mixer plant and cableways is effected by two 3-ft. gage industrial tracks laid along the head-tower track but outside of the building lines. The cableways were considered by the contractors to be the only practical way to distribute so much concrete over such a large area in comparatively thin sections.

GRAVITY MIXING PLANT

Every morning a contractor's special train of 40 bottom-dump cars of sand and gravel arrives on a regular schedule of the Erie Railroad at the mixing plant, having been loaded the previous day at Akron, Ohio, 40 mi. to the south. A trestle, 15 ft. high, has been constructed back of the mixer plant long enough to accommodate three cars of sand and three cars of gravel while dumping at one time. Space on each side of the tracks has been provided for 4000 and 6000 cu. yd. of sand and gravel respectively. A locomotive crane equipped with a 1-yd. Hayward clamshell bucket fills the day hoppers over the mixers and then proceeds to transfer the material from points directly under the trestle out to the limit of the 60-ft. boom.

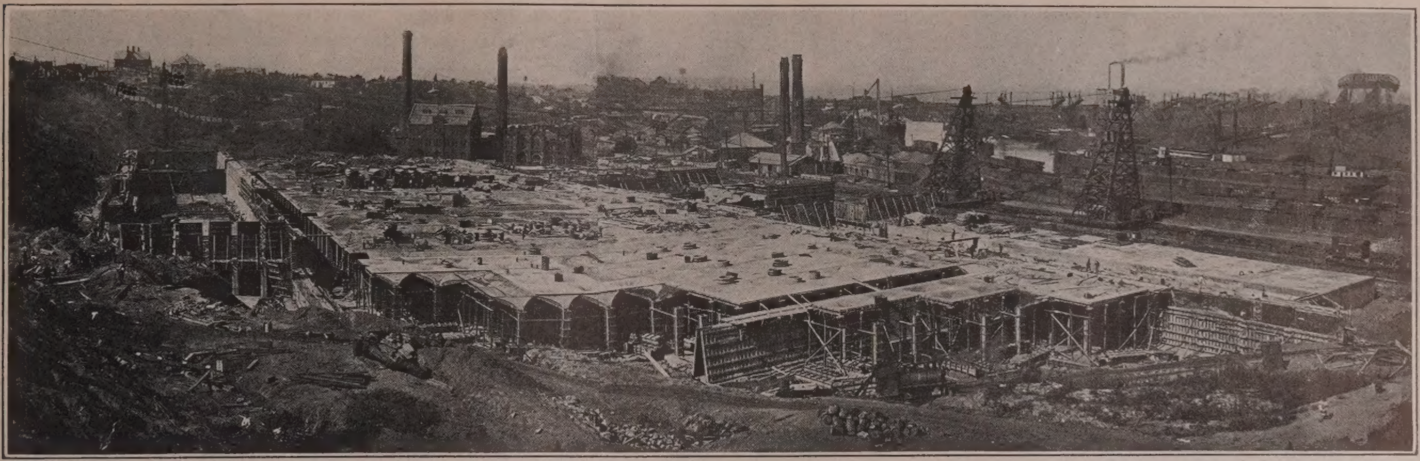
Only a small supply of cement is maintained in the fifteen-car cement house at the foot of a 24-in. Jeffrey belt conveyor, which delivers the bags to the mixer charging floor. Universal Portland cement is used on this work. Most of the time the bags are unloaded directly from the cars onto the conveyor, demurrage on cars being considered more economical than the extra handling.

In the mixer plant proper are two 1-yd. Haines gravity mixers, each provided with four charging hoppers. Separate chutes from the gravel and sand bins are provided for each hopper and one man is assigned to each hopper. Thus far only one of the mixers has been used, except for a single day when repairs were necessary. One of the industrial tracks serving the two mixers extends under the material trestle, where a special trap is maintained to load cinders, gravel or other material onto the industrial cars.

FIVE-YARD BUCKETS

In transporting the concrete from the mixers to the cableways, the two-car trains are loaded with a single loaded or empty 5-yd. Haines' bottom-dump bucket. Four engines are provided, but it is usual to employ one train only unless the forms are quite near the tail-tower.

A rate of one bucket each 3½ min. has often been maintained as long as forms



PANORAMIC VIEW OF CLEVELAND FILTRATION PLANT SHOWING TWO CABLEWAYS SPANNING SITE

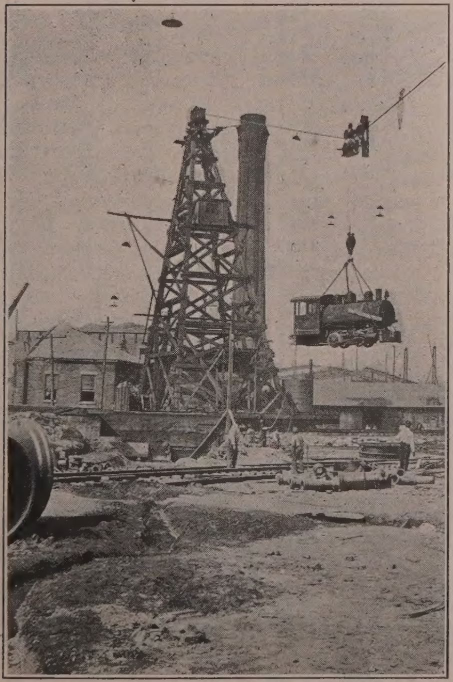
were available. The maximum amount poured in a 24-hr. period was 1620 cu. yd. and in 10 hr. of this same day, 1200 cu. yd. were deposited, all in comparatively thin sections including one filter, coagulating basin roof, dividing wall and mixer chamber floor.

The 75-ft. head-towers of the two cableways run on the bluff, 90 ft. above the general elevation of the plant and 730 ft. away from the 95-ft. tail-towers. Operation of the cableways is effected by 40-hp Lidgerwood steam engines.

Paralleling one of the 2¼-in. Roebling cables is an electric light cable suspended from booms on the towers. Lamps of 750 and 1000 cp are spaced on the cable 50 ft. apart. Connections are made at the base by means of an ordinary trolley. Night work has been carried on about 90 per cent of the time.

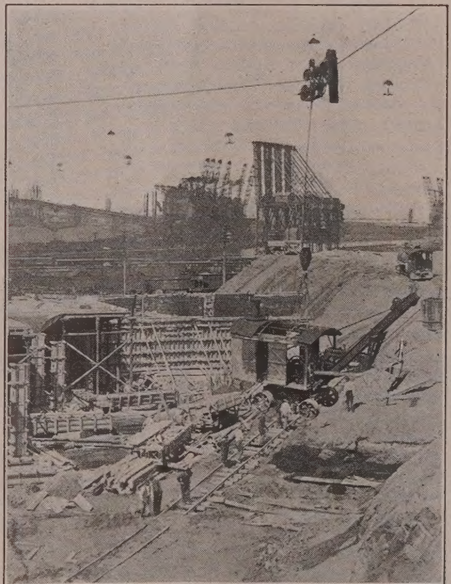
FORM SHEET DETAILS

With the large number of thin high walls, especially in the mixing basin, the value of making all wall forms in interchangeable sheets was deemed advisable by the contractor. These sheets were made up uniformly in 16-ft. lengths on an outdoor platform at the saw mill. The original heights were made for the highest walls.



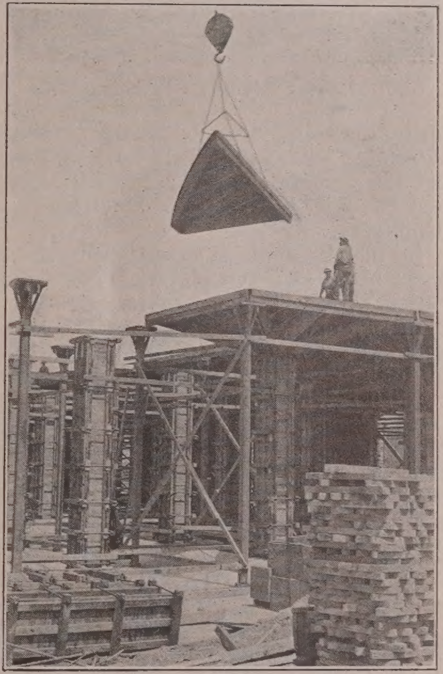
CABLEWAY MOVING DINKEY LOCOMOTIVE

While the design is simple, it is given here because no walls have been lost, and progress has been expedited by using these sheets. Dressed and matched yellow pine boards, 1 in. thick, are nailed to 2 x 6-in. studs spaced on 16-in. centers. Alternate ends have a 3¼-in. lap and a 1¼-in. rabbet by spacing the studs these distances away from and beyond the ends of the 1-in. boards respectively. All sheets are bored at the mill for ⅝-in. rods to secure the 4 x 6-in. wales. Beginning at the bottom the latter are spaced vertically on 6, 12, 18, 24, 30, 36, 42 and continuing 42-in. centers. In erection the rods are screwed into a Casey patented coupling which is like a short pump rod coupling with two lugs on it to prevent turning in the concrete. On the outer end of the rod is a large metal washer and nut. To Oct. 1, 70,000 couplings had been used. Wall sheets required in each mixer basin number eighty and enough were provided for two basins. Crude oil was applied to each form originally and at least after every third time in service.



SHIFTING STEAM SHOVEL

For the inverted groined-arch floors the usual methods were used. Alternate sections with the points under the columns were poured between diagonal templets. Former methods were also used in the groined-arch roof, the quarter-panel forms being set by the cableway. Enough roof forms were provided for one and one-quarter coagulating basins and enough filter forms for ten units.



HANDLING GROIN FORMS WITH CABLEWAY

ARCHES UNINJURED BY DROPPING 5-YD. BUCKET

The value of the four ½-in. steel rods placed in the crowns of arches to prevent any tendency to topple during construction was demonstrated when one of the 5-yd. buckets, full of concrete, dropped 10 ft. on a 10-day old arch from which the forms had been removed. The only damage was two small holes made by the legs of the bucket.

In the pipe gallery the two lines of 48-in. pipe for wash-water and influent are supported by concrete frames with saddles cast in the crossbraces. The lower cast-iron wash-water line was erected first, the frames poured and then the riveted steel supply line erected on top.

SHOP EQUIPMENT AND PLANT

For repair and new work the machine shop is equipped with two forges, one Erie steam hammer, one Little Giant pipe threader, one drill press, one 24-in. lathe and one power hack saw, all driven from a jackshaft by a 5-hp motor. An Ingersoll-Rand two-stage air compressor, automat-

CONCRETING INVERTED FLOOR GROINS

ically controlled and driven by a 20-hp Westinghouse motor, supplies air throughout the work to the carpenters for boring and to other workmen for riveting and drilling.

In the carpenter shop are two Fay & Egan band saws, two rip saws, two swing cut-off saws, a boring machine, all driven by a 10-hp motor from a jackshaft. Portable saws driven by gasoline engines are maintained at various places where form erection is taking place.

Outside equipment comprises two McMyler-Interstate locomotive cranes, one standard gage switching engine, one Thew and one Marion shovel, one Ransome portable mixer, fifteen 4-yd. Western and Kilbourne & Jacobs dump-cars and four Porter dinkeys.

CONTIGUOUS WORK

Other contracts on adjoining structures let to the same contractor and now under way, utilizing much of the same equipment as contract 1, are the chemical house, wash-water tank and the foundations of the new pumping stations which will house two pumps in the old station now being razed, and three new Allis-Chalmers units of 70,000,000-gal. daily total capacity. For the excavations of the former structures the digging equipment of contract 1 was supplemented by a stiffleg derrick with a 70-ft. boom erected on a concrete pedestal 25 ft. high, sunk below the finished level. A traveling A-frame derrick with a 50-ft. boom assists in telegraphing earth skips and concrete buckets to and from the industrial track.

Foundations for the new pumping station are being excavated 16 ft. deep inside of a line of 30-ft. United States steel sheet piling driven by Vulcan and Arnott steam hammers before the excavation began. In clearing the site several lines of cast-iron pipe were removed, the usual procedure being to break them up with a 2700-lb. drop hammer. Raymond concrete piles will be driven to hardpan before placing the 3-ft. concrete matt under the engine beds.

The John F. Casey Company is the contractor for those parts of the filtration plant and pumping station described.

C. F. Schulz is commissioner of water of the city of Cleveland, reporting to the director of public utilities, C. W. Stage. R. Winthrop Pratt is consulting engineer and F. H. Stephenson in charge of design on the filtration work. R. S. Jones is in charge of construction of the filters and pumping station.

Penetrance of Creosote

Conclusions and Table Derived from Experiments to Determine Relative Resistance of Various Conifers

MENTION was made in the book reviews of Oct. 31 of Bulletin 101, issued by the U. S. Department of Agriculture, on the relative resistance of various conifers to injection with creosote, based on a series of experiments. One of the tables presented by the author of the bulletin, C. H. Teesdale, engineer in forest products at the Forest Products Laboratory, Madison, Wis., is given herewith in slightly condensed form, as are Mr. Teesdale's conclusions as follows:

Radial and longitudinal resin ducts penetrate intimately the interior of the wood and thus form passages for the preservative. Radial resin ducts were found to be especially important. Where these occurred the wood was usually penetrated radially from one-fourth to three-fourths as far as longitudinally, and tangential penetration could usually be disregarded. Where no radial ducts were present, radial and tangential penetrations could be considered as equal, and they were found to be between one-twentieth and one one-hundred-twentieth of the longitudinal penetrations.

Absorption curves platted for the specimens treated show that those species which were most difficult to impregnate gave the most uniform absorption results, and that the sapwood of those species containing resin ducts gave the most erratic absorption results. They showed also that sapwood of pines, as distinguished by its color from heartwood, was not always easier to treat than the heartwood. The color line in the wood does not necessarily separate the easily treated wood from the portions treated with difficulty. Some sapwood treated like heartwood and some heartwood treated like sapwood; all of these conditions are possible in the same cross-section of a tree. As a consequence of this, the absorption curves for pines were, as a rule, very erratic, especially the sapwood curves.

The results obtained with a given species of wood cannot always be applied to another species, however similar in structure the two may appear to be. This fact is strikingly evident in the treatment of heartwood larch and tamarack. Even woods of the same species show variations when grown under widely different conditions, as, for example, Western yellow pine from California and from Montana.

A WORKING MODEL of the New York State Barge Canal, occupying 2600 sq. ft. and showing locks, terminals and boats of a type likely to be operated thereon has been shipped for exhibition at the Panama-Pacific Exposition in San Francisco next year. The model was prepared under the direction of John A. Bensel, State engineer and surveyor.

ORDER OF SPECIES IN RESPECT TO LONGITUDINAL AND RADIAL PENETRATIONS AND ABSORPTIONS

Species	Character of wood*	Penetrance tests				Impregnation tests, absorption per cu. ft.	Order of species in respect to			Average dry weight per cu. ft.
		Average time of treatment	Time required to penetrate 12 in.	Average longitudinal penetration	Average radial penetration		Longitudinal penetration	Radial penetration	Absorption	
		Min.	Min.	In.	In.	Lb.				Lb.
Douglas fir	H	70	..	0.57	0.05	4.38	1	2	4	32.5
Tamarack	H	70	35	0.87	0.04	1.26	2	1	1	33.5
Lodgepole pine	H	52	..	0.98	0.63	12.84	3	25	12	25.1
Spruce pine	H	70	..	1.65	0.30	17.58	4	20	26	34.4
Alpine fir	H	70	..	1.73	0.11	3.66	5	7	2	25.2
Shortleaf pine	H	70	..	2.75	0.35	15.36	6	21	17	39.7
Engelmann spruce	H	75	..	2.83	0.83	8.64	7	27	7	27.2
Western larch	H	70	15	3.17	0.09	15.72	8	11	18	34.1
White spruce	H	70	..	3.27	0.09	6.42	9	9	5	25.6
Yew	H	70	..	3.42	0.08	12.36	10	8	9	38.8
Western yellow pine, Montana	H	70	..	4.42	1.25	16.14	11	29	20	25.0
Jack pine	H	70	..	4.43	1.27	12.36	12	30	8	28.8
Redwood	H	77	..	4.58	0.16	18.78	13	16	29	20.5
Alpine fir	S	70	..	5.50	0.07	4.14	14	6	3	22.7
Noble fir	H	65	14	5.83	0.12	12.60	15	14	11	24.1
Douglas fir	S	70	20	6.10	0.43	14.46	16	23	15	30.9
Eastern hemlock	H	70	35	6.67	0.07	17.28	17	5	25	23.4
Eastern hemlock	S	45	..	6.75	0.05	18 78	18	3	28	20.3
Redwood	S	70	..	6.87	0.13	21.06	19	15	33	20.2
Western hemlock	H	70	30	7.42	0.06	17.16	20	4	24	30.8
Western yellow pine, California	H	61	48	7.60	0.72	16.08	21	26	19	28.9
Western hemlock	S	70	30	8.27	0.09	17.04	22	10	23	32.0
Loblolly pine	H	60	½	8.33	0.85	18.12	23	28	27	35.9
White fir	S	65	15	9.00	0.18	18.96	24	18	30	24.1
Sitka spruce	S	45	9	9.33	0.10	16.98	25	13	22	19.7
Lodgepole pine	S	21	½ to 40	9.67	(†)	31.56	26	37	38	23.6
Longleaf pine	H	70	16	9.83	0.38	12.90	27	22	13	39.2
White fir	H	70	24	10.05	0.20	21.54	28	19	34	23.4
Noble fir	S	70	3	10.33	0.18	16.20	29	17	21	24.8
Western yellow pine, California	S	15	10	4.50	0.54	15.12	30	24	16	29.8
Sitka spruce	H	70	23	12.00	0.09	13.44	31	12	14	18.5
Spruce pine	S	3	5	†12.00	(†)	29.46	32	33	37	30.8
Engelmann spruce	S	2	½	6.83	0.37	22.20	33	31	35	30.9
Shortleaf pine	S	2	½	†12.00	(†)	20.76	34	32	32	35.3
Longleaf pine	S	1	1	†12.00	(†)	34.20	35	35	39	25.2
Western yellow pine, Montana	S	1½	½	†12.00	(†)	28.74	36	34	36	25.9
Loblolly pine	S	½	½	†12.00	(†)	20.40	37	36	31	37.3
White spruce	S	..	..	....	....	8.22	..	..	6	26.1
Jack pine	S	..	..	....	....	12.42	..	..	10	30.7

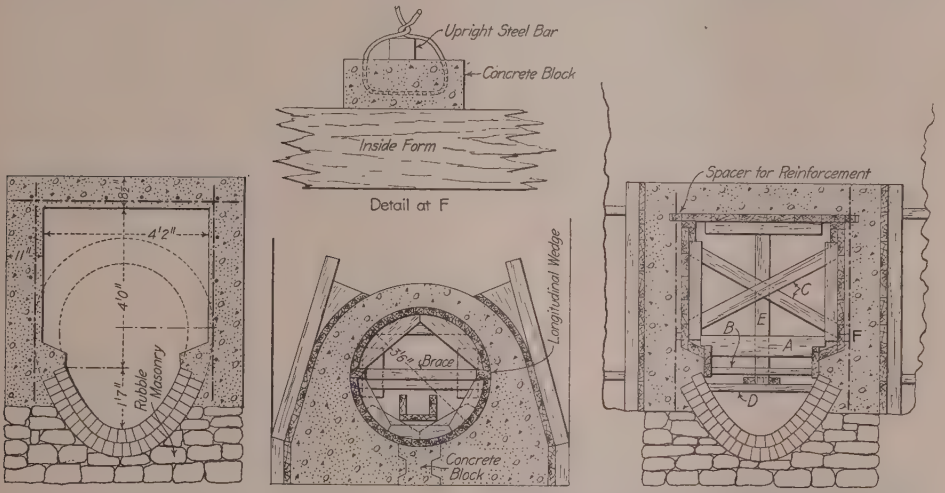
*H indicates heartwood; S, sapwood.
†Complete.

Enlarging an Old Egg-Shaped Brick Sewer

Method Involved Utilization of Existing Invert and Use of Reinforced Concrete to Widen Section at Top—Details of Collapsible Forms

By G. L. CHRISTIAN
Assistant Engineer, Bureau of Sewers, Borough of Bronx, New York

TO increase the capacity of an egg-shaped brick sewer in Tinton Avenue, between Westchester Avenue and East 165th Street, New York City, the upper portion of the section was broken out and rebuilt with reinforced concrete while the old invert was left and incorporated as part of the new work. The original sewer ranged in size from 3 ft. 2 in. x 4 ft. 2 in. to 2 ft. 2 in. x 3 ft. When the existing system was designed this section of the city in the Borough of the Bronx, was strictly suburban, but has since been built up solidly, and the streets and yards have been paved. Owing to the changed conditions the capacity of the sewer became inadequate, and it became necessary to rebuild it.



ENLARGED SECTION OF TINTON AVENUE SEWER AND DETAILS OF WOODEN FORMS

CARING FOR FLOW

During the reconstruction it was not only necessary to care for the storm water and sewage, but also for the drainage coming through the connections from each house fronting on the sewer under repair. It was, therefore, decided to utilize the invert of the existing brick sewer, remove the arch, widen out the section as shown in the drawing, and rebuild the upper part of the structure of reinforced concrete. The sewer as rebuilt was 4 ft. 2 in. wide at its lower end and 5 ft. 7 in. high; the section was stepped down at intervals until at its upper end it measured 3 ft. wide and 3 ft. 7 in. high. The concrete was composed of 1 part Portland cement, 2½ parts sand, and 5 parts screened ¾-in. gravel, and was reinforced with corrugated steel bars. Four cuts were made and the work of excavating progressed simultaneously in each.

SETTING FORMS

When the excavation had been removed to the proper lines and grade and all the broken house connections repaired, the forms, which are of wood in sections 12 ft. long, were set in place and properly braced, the procedure being as follows:

Pieces *D* (see drawing) were set in the old invert at intervals as needed, and a board walk, one plank wide, was laid on them. The side forms were next set up and fastened in position with 2 x 4-in. cross-braces *C C* placed 3 ft. center to center. Pieces *B* and *A* were next driven in tight, thus holding the bottoms rigid against the brick work. Two longitudinal wedges were next laid on top of each side form, to support the roof form, after which the 3 x 4-in. upright *E* was set up on *D* and wedged snugly against the roof. A 2-in. piece, notched to hold the steel bars in position, was then lightly nailed along each side of the roof form.

PLACING THE STEEL BARS

The upright steel bars which were next put in place, were held in position on the bottom by a concrete block, resting against the form, as shown in the drawing. The longitudinal bars were wired in position on the uprights, and then the outside form was placed in position and properly braced. The concrete, which was mixed very wet, was placed in the side walls and thoroughly spaded. The notched strip at the top of wall was removed, the steel bars placed in position in the arch resting on concrete blocks, and the concrete for the arch placed immediately thereafter. Another section was then prepared for rebuilding, and after the concrete had set sufficiently the outside forms were loosened and pulled ahead. The braces *C C*, the longitudinal wedge above the side forms, the upright *E*, and the braces *A* and *B* were then removed in the order named, allowing the form to collapse and be removed ahead to the next section.

The concrete was all placed by one gang and was mixed by hand alongside the trench. The gang moved from cut to cut, putting in each day a section of sewer of an average length of 37 ft. A track was laid alongside each cut on which was placed a Wilson hoister and traveler, which was used to hoist the excavated material out of the cut.

REPLACING 12-INCH SEWER

In East 160th Street a 12-in. pipe sewer was replaced by a 3 ft. 6-in. circular concrete sewer. In the construction of this sewer, wooden forms were also used. They were made in two parts, each slightly less than half the diameter, the lower half being made up in sections 6 ft. 6 in. long, while those in the upper half were 13 ft. long. The requisite number of concrete blocks 12 in. square by 12 in. thick, keyed on four sides, were made some weeks in advance and kept damp until cured. When ready to begin construction the blocks were placed with their tops to line and grade and spaced 6 ft. 6 in. center to center, the lower half of the forms being then laid on the blocks, followed by the upper half.

Between the upper and lower half was placed on each side a longitudinal wedge extending the full length of the forms. The forms were then fastened together and braced in place, after which the side forms for 1 ft. in height were set in position and the placing of concrete commenced. Work was carried on continuously until the section was completed. The side forms, which were made in two parts, were placed in position as the work progressed. Before placing the forms a small wooden flume was hung on the side of the trench to intercept the flow from the broken house connections and carry it to another flume, which conveyed the sewage from the 12-in. pipe through the wooden forms and deposited it at the lower end in the completed section.

After the concrete had properly set the wedges were removed, dropping the upper half of forms which were then drawn out, after which the lower half was removed. This method of doing the work has proved both economical and satisfactory.

LABOR COSTS

Some of the actual labor costs are as follows: Setting up and removing forms, a total cost of 2 cents per square foot of form, or 71 cents per cubic yard of concrete. The concrete was mixed by hand alongside the trench and shoveled directly into a chute which emptied into the forms, and cost a total of 56 cents per cubic yard to mix and place in the work.

In Forrest Avenue a 24-in. vitrified pipe sewer was substituted for a 15-in. pipe the work being carried on in the following manner: The existing sewer was first completely uncovered for a convenient length, after which a wooden box flume was laid along one side. A dam of sand bags was next made at each end, a length of pipe removed and the flow turned through the flume. The existing sewer was next removed and the trench prepared for the new sewer. In relaying the new sewer, the first pipe was laid at the downstream end and just one length from the permanent work, leaving a gap into which a pipe had to be inserted upon the completion of the pipe laying in the section of trench that was included between the dams. The trench was then refilled, a stretch adjoining uncovered and the work continued as before. It cost 16 cents a lineal foot to lay the 24-in. pipe, with the exception of the end pipe in each section which cost about 34 cents per lineal foot.

The existing brick sewer at its lower end had a capacity of 81 cu. ft. per second, which the reconstruction has increased to 180 cu. ft. per second.

The contract price was $59,620.30 and the time actually consumed in doing the work was about 200 days. The work was done under the authority and direction of Douglas Mathewson, president of the Borough of the Bronx; R. H. Gillespie, chief engineer of sewers and highways; Josiah H. Fitch, engineer of sewers, and the writer, assistant engineer in direct charge of the construction. John J. Hart was the contractor, and David Canavan, superintendent.

Details of Construction Which Make Brick Pavements Good or Bad

Comments Based Upon Inspection of Old and New Work During 200-Mile Trip Over Highways in Upper New York State

By F. A. CHURCHILL
Of the Dunn Wire-Cut-Lug Brick Company

THE importance of details as factors of good-roads construction is emphasized by the brick highways in Erie and Niagara Counties, New York, which were inspected during the recent annual convention of the National Paving Brick Manufacturers' Association, at Buffalo. Good construction, bad construction and intermediate grades were exemplified. Different kinds of brick, and different makes of the same kind of brick have been used, but while the brick highways range in quality from bad to perfect the differences among them are not wholly attributable to variations in the quality of brick. Both good and bad roads are built of the same kind and make of brick, and sometimes the same contractor built both kinds of roads with one kind of brick.

A noticeable distinction between types of brick was found in the fact that even on roads of inferior construction the sections laid with square-edge brick were uniformly better grouted than were sections of the same roads laid with round-edge brick, although instances of faulty grouting occur with both types of brick.

DAMAGE AT EXPANSION JOINTS

The contractor has not been at fault in all cases, although his sins of omission and commission are many. The worst roads are those having cross expansion joints. Pavements otherwise in good condition show courses of broken and sunken joints at regular intervals of 50 ft. on account of transverse expansion joints. In some instances courses of brick on each side of the cross expansion joint are broken. But cross expansion joints were specified, and the contractor was obliged to put them in.

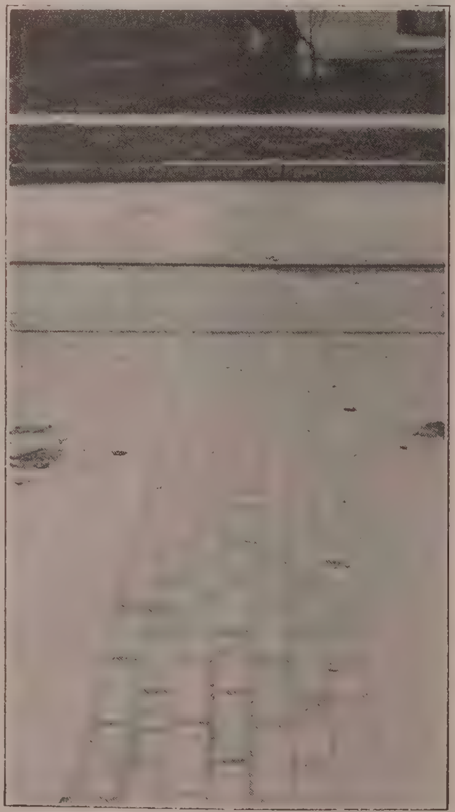
The best pavements, and the only perfect pavements, were those having longitudinal expansion joints only, although not all pavements having longitudinal joints were found in good condition. It can, however, be affirmed, without fear of successful contradiction, that neither in Erie County nor in Niagara County was there seen a cross expansion joint pavement in perfect condition after two years of service. On some highways, notably road No. 2, running out of Hamburg, cross expansion joints and longitudinal expansion joints occur in different sections of the same road; but in every instance cross expansion joints show at a great disadvantage.

GROUTING AND ROLLING

The visitors received ample proof that a perfect brick highway can be laid and that it will remain unimpaired under traffic conditions for years. The reverse of the picture was exhibited as well. Slipshod methods of construction have been responsible for poor pavements. Faulty foundations and poorly prepared sand cushions are accountable for some defects, but by far the most prolific cause of poor pavements—excepting cross expansion joints—is poor grouting. Poor materials and materials mixed in wrong proportions contribute to poor surfacing, but as a rule either ignorance or carelessness in applying the grout is the source of failure. Too much care cannot be exercised at this stage of construction, but observation teaches that some contractors attach little importance to the details of grouting.

A tour over construction work discovers another cause of poor pavement in the laying of long stretches of brick ahead of rolling and grouting. This method is destructive in case of rain, as brick on a wet sand cushion cannot be rolled without forcing the sand up between the joints. This disrupts the smooth, compacted bed upon which the brick rest and the sand between the bricks prevents the bonding material from penetrating to the bottom of the courses and forming a strong bond. Brick rolled on a wet sand-cushion will rock, nor can a smooth, even pavement be made with a wet sand cushion under it. Contractors are not ignorant of these facts but they take chances and sometimes, unless closely watched by the engineer in charge, they grout over a pavement laid on a wet sand cushion and cover up their folly temporarily. It saves taking up the brick and relaying them. It is easy to uncover such fraudulent work by pulling out a brick here and there, and noting how far the sand has been forced up by the rolling of the brick.

All work should be rolled before leaving it at night. The roller should follow the pavers closely and the grouters should keep as close to the roller as practicable, closing up the work each night. Yet sometimes engineers permit contractors to lay a quarter of a mile or more of brick ahead of the grouters.



SEVEN - COURSE PITCH - FILLED TRANSVERSE JOINT AT 50-FOOT INTERVALS

Note broken brick in joint and sound brick in grouted work at either side

Two evils arise from this course—first, the danger of rain on the sand cushion; second, the mixing and the dumping of too much filler at one time in order to rush the work. Unless closely supervised grouters will mix batches too big, and they will put enough grout on the pavement to grout 15 ft. instead of the maximum permissible limit of 5 ft. The inevitable result of putting an excess of grout on a pavement at one time is the same as the result of mixing batches that are too big, namely, separation of sand from cement and consequent weakening of the bonding material. Bridging of joints is another peril from dumping grout on the pavement.

PROPORTIONING GROUT

Another observed tendency of grouters is to mix the final coat of grout too thin or too thick. If too thick, the grout bridges the joint; if too thin it settles in the joints instead of setting flush with the pavement. The general tendency is to mix the first grout too thick and the final course too thin. The final grout should be somewhat thicker than previous courses, but it should not be too thick nor should too much of it be put on at one time; it is imperatively necessary not only that the batch be kept thoroughly mixed but it must be thoroughly squeegeed into the joints. In one instance workmen were observed thinning grout by pouring water on it on the pavement, thereby separating the constituent elements of the grout and destroying its efficiency. This fault was corrected, but there is reason for believing that that method of thinning grout is somewhat general. The right way, therefore the only way allowable, is to thin in the grout box and keep constantly stirring.

Contractors and engineers, unless thoroughly experienced in highway work and conscientious in their work, are prone to neglect or slight what appear to be minor details, nor in their methods do they always discriminate between the two kinds of brick commonly used for paving.

METHOD OF FINISHING GROUTING

The method of finishing the grouting of a brick pavement differs with the type of brick used. The final course of grout on a round-edge brick pavement should be squeegeed until the surface of the pavement is as nearly as practicable free from grout; otherwise, when the excess grout breaks under the pounding of traffic and comes off, it will pull portions of the grout from the round-edge joints. No such danger from a heavy surface coating of grout menaces a pavement laid with square edge brick. The square edges of the brick protect the joint and the excess of grout comes off the pavement without impairing the grout at the joint. The difference between round-edge brick and square-edge brick in respect to the final grouting is this: Whereas in the case of the former all the surplus grout ought to be squeegeed off the pavement, in the case of the latter the surplus may be taken off or left on without deleterious effect. The objection to leaving a thick covering of grout over the pavement is that it is unnecessary and, therefore, wasteful.

The tour of the brick roads of Erie County disclosed the fact that in some instances the failure of contractors properly to protect the freshly grouted pavement with a blanket of moistened sand had resulted in too rapid setting of the filler. The result was "crazing" and pin-cracking of the grout. The same condition was found on the Kennilworth Avenue pavement recently laid by the city of Buffalo.

LAYING THE BRICK

Brick laid with lugs the wrong way brought together two smooth sides of adjoining brick, thereby preventing the penetration of filler and preparing the way for defective spots in the completed pavement. Such faults are the result of inexcusable carelessness, but competent engineers and inspectors detected them in time to forestall serious consequences.

Another indication of neglect to follow specifications was observed in the placing of the uneven or broken edges of bats next to the curb. This is not, perhaps, a serious structural defect, yet it is both æsthetically and practically wrong. It detracts from the symmetrical appearance of the pavement at the sides by giving it a rough, uneven edge, and it deprives the pavement of the extra bonding strength afforded by union of the filler with the rough surface of the bat. Some persons may regard these strictures as hypercritical, but no detail of construction is negligible. A good pavement represents the homogeneous aggregate of all constructive details properly wrought out.

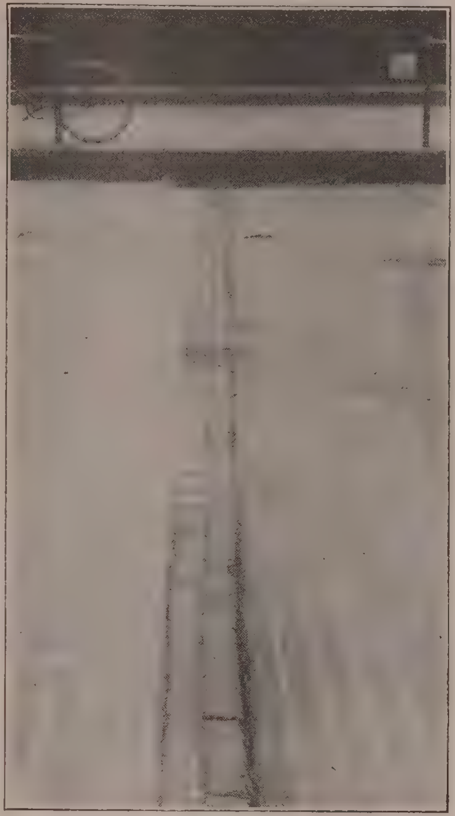
FOUNDATION DRAINAGE

The necessity for proper drainage of foundations was strongly impressed upon observers of brick highways in Erie and Niagara Counties. There are miles upon miles of pavements without cracks, sunken spots, broken bonds or other noticeable defects, yet several highways show cracks and sunken spots unquestionably due, in the first instance, to ineffectual drainage. While it is probably true that longitudinal cracks sometimes result from causes other than defective drainage, a well-constructed foundation, properly drained, is a sure preventive of sunken spots in a pavement, nor are cracks likely to occur unless moisture is taken into the foundation either by direct contact or by capillary attraction.

The tour of inspection around Buffalo found apparent evidence of negligence in the matter of drainage, but conclusive proof was adduced that a well drained and well constructed grouted brick pavement is impervious to surface water. Portions of the brick boulevard running from Buffalo to Niagara Falls were submerged by the flood a couple of years ago, for a period of two or three weeks, yet they were absolutely unharmed and were marked neither by cracks, nor depressions, nor by broken bonds. Damage to brick pavements resulting from moisture originates beneath the foundation. That the problem of drainage can be solved even under adverse natural conditions is a fact which was demonstrated on the tour.

CULL BRICK

For almost its entire length of 23 miles the boulevard between Buffalo and Niagara Falls runs through a level country, and the same is true of the highway between Lewiston and Youngstown. Yet in the former only a few bad spots exist, and in the latter none at all. The worst spots on the boulevard are attributed to the use of cull brick. This brick, it is alleged, was condemned in Niagara County, but by some means the culls found their way across the line into Erie County and were placed in the pavement at two points. It might be an idle waste of time to speculate on the sequence of events which eventuated in the translation of brick from a cull pile in one county to a snug place in a State boulevard in the county adjoining, but it is only fair to say that the manufacturer who furnished the brick says he received cull prices for the cull brick and was not cognizant of the high destiny which awaited them. Without attaching to the incident any remote significance, the incident does emphasize the need for close supervision of construction work by engineers in charge, and it puts an acute accent on the necessity for honest, capable and diligent inspection. Eternal vigilance is the price of a good pavement.



CROSS EXPANSION JOINT ORIGINALLY ½ INCH IN WIDTH

Note how bond has been broken in the two adjoining courses of blocks

INSPECTION

Poor judgment of the qualities of brick is a weakness not infrequently found in inspectors. Among culls thrown into the discard by inspectors on construction work were found what practical men declared to be the very best brick in the shipment. Conversely, some of the brick that were passed were of inferior quality. Without making any specific application to individuals or to any particular job, it is safe to affirm that inspection of brick on the roadway is to some extent a matter of individual preference, and in many cases inspectors are not qualified by experience or by native ability to judge correctly of the quality of brick by its appearance. The result is an almost total absence of uniformity in standards of judgment and an insistent demand for a better system, or at least for expert inspection.

There does seem to be among inspectors a common prejudice against brick of a dark shade, although it is quite possible that such brick may be exceptionally durable. The shade is not always an indication of overburning. The inspection of brick is often delegated to persons selected without regard to their fitness for the duty; and brickmakers may be mulcted from 2 to 3 cents per brick on large consignments by the ignorance of inspectors appointed for political reasons or for other reasons equally obnoxious. Nor is the abrasion test always fair to the brickmakers.

These reflections and comments are based upon observations made on old and new work in a recent tour of 200 miles over highways in Erie County and Niagara County, New York.

Lifting Irrigation Water 110 Feet at Lehigh, Utah

Features of Pumping Station on Utah Lake—Foundations on Quaking Clay—Machinery on I-Beams Embedded in Concrete Floor

WATER from Utah Lake is pumped 110 ft. high near Lehigh, Utah, to irrigate 20,000 acres of land lying parallel to the West Jordan Canal built twenty-five years ago. At present three motor-driven centrifugal units having capacities of 5, 10 and 22 sec.-ft. have been installed by the Utah Lake Irrigation Company, but the plant is laid out to be extended by the addition of seven more units of the larger size. Water is furnished in total quantities of 2 acre-feet per acre at the maximum rate of 1 sec.-ft. for 100 acres.

Several years ago the level to which Utah Lake might be allowed to rise was the subject of a dispute between those who owned property on the flat shores and those who wished to raise the controlling works at the outlet of the lake into the Jordan River. A level called the "compromise point" was finally agreed upon. The Utah Lake Irrigation Company's filings entitle it to pump water until the lake reaches a level approximately 6 ft. below the "compromise point." This is about ten times the storage required. In fixing the pumping station elevations the floor was placed 1 ft. above a possible high water due to wind, or 3 ft. above the "compromise point." The pump centers are set so as to pump under a maximum suction lift of 14 ft., or 6 ft. below the compromise.

FOUNDATIONS OF PUMPING STATION

Foundations for the building rest on quaking clay, as the bedrock is far below the surface at an unknown depth. Heavy walls, 4½ ft. thick, therefore, were built under the longitudinal superstructure walls, and the sub-floor under the suction well, which occupies the whole space uninterrupted by columns or cross walls, was reinforced for upward hydrostatic pressure. These walls are of 1:3:5 mixture in which niggerheads obtained nearby form about 30 per cent of the volume. Sand and gravel were hauled about ½ mi.

The inlet channel to the common suction chamber is 600 ft. long, and has embankments on each side, 14 ft. wide on top, and 10 ft. deep, with side slopes of 1½:1. Over the inlet at the station ahead of stop-log grooves are screens consisting of ⅛ x 2-in. bars spaced on 1-in. centers and inclined on a slope of six horizontal to ten vertical.

Pumps of the large units are of the Allis-

Chalmers double-suction type with 18-in. suctions and discharges. The rated capacity of 22 sec.-ft. was guaranteed to be attained when running at 1170 r.p.m. under a head of 114 ft. The 400-hp squirrel-cage Allis-Chalmers motors use current at 2300 volts. The whole apparatus from switchboard to pipe line had a guaranteed efficiency of 67.8 per cent. During tests made by the engineers a corresponding efficiency of 71½ per cent was obtained.

The machinery rests on reinforced-concrete floor slabs supported by embedded 12-in. I-beams spanning the distance between the longitudinal walls of the substructure. The electrical transforming and high-voltage switching apparatus are contained in a separate room, a continuation of the pump room. The superstructure has brick walls and steel roof trusses covered with ship-lap and King shingles. Pending extensions the pump-house end of the building is closed with galvanized iron plates.

INCREASING PIPE SECTION TO REDUCE LOST HEAD

Special precautions were taken in the design to reduce the head lost in entering the discharge mains through gradual increase in the pipe cross-section after passing the valves. This special steel pipe work was done by the Provo Foundry & Machine Company, which also furnished the 10-ton hand crane.

Ascending the hill to the ditch is a 49-in. wood-stave pipe, 2000 ft. long, built by Owen H. Gray, of Salt Lake. Staves are cut from Oregon-fir 2 x 6-in. timbers. The pipe line enters the distribution canal through a concrete headbox and presents no unusual features.

A unique contract for buying power from the Utah Light & Power Company is intended to foster early irrigation when the power company has an excess of power, as its hydroelectric stations are on streams subject to spring flood flows. During April, May and June power costs 0.7 cent per kilowatt-hour, during July 0.7½ cent, during August and September 0.8 cent.

In the distribution system the three districts, each under about 5 mi. of ditch, are separated by natural barriers, the company selling water at $40 per acre in the nearest district and adding $10 per acre for the second and $20 for the third section. An egg-shaped tunnel lined with 6 in. of concrete driven through 5000 ft. of clay and cemented gravel separates the first two sections of land. Between the second and third is a 5000-ft. siphon of 48-in. wood-stave pipe under a maximum head of 180 ft.

The work was completed and put into operation during 1913. The company was organized and is now managed by J. R. Murdock, manager and president. R. P. Fairbanks was the electrical and mechanical engineer and had charge of the design and construction of the pump house and pipe line. C. S. Jarvis was civil engineer in charge of the design and construction of the canals, tunnel and wood-stave siphon. With the exception of the pipe line the work was done on force account.

SAFETY AS PART OF THE EDUCATION of an engineer was the theme of a paper read by C. B. Connelley, dean of the school of applied industries, Carnegie Institute of Technology, before the third annual Safety Congress, held in Chicago, Oct. 13 to 15. According to Dean Connelley, a course in safety engineering is now being demanded of the engineering schools, and at least two colleges in the United States have inaugurated a special course in safety engineering, leading to the degree of S. E. The special qualifications are a sound grounding in mathematics, mechanics, physics, general chemistry, drawing, languages and economics.

Test of 75-Ton Steel Derrick

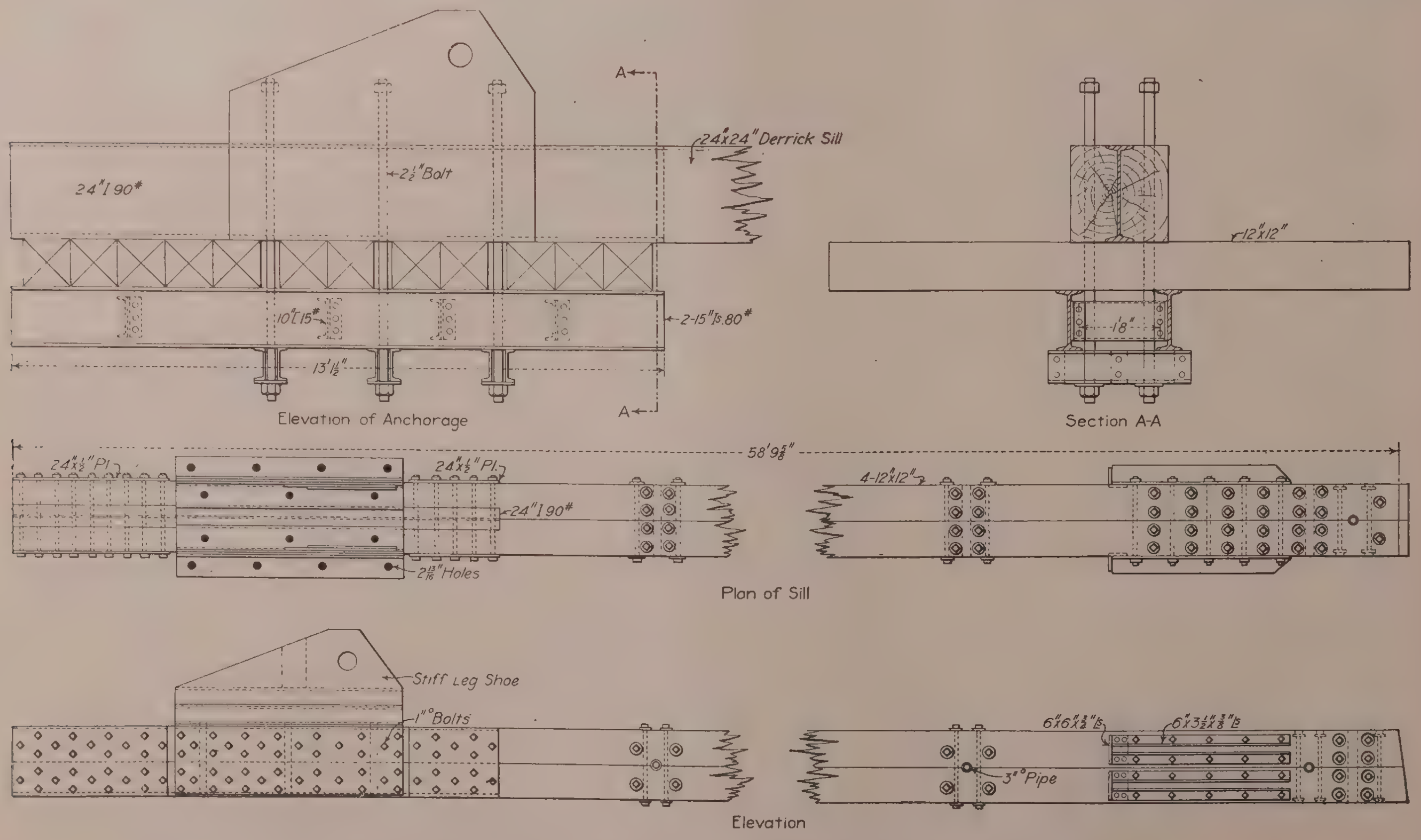
Wooden Sills and Anchorages Provided for Temporary Installation on Sand—Heavy Guns Raised, Swung and Lowered in Satisfactory Manner

THE 75-ton stiffleg steel derrick designed and constructed by the Terry & Tench Company, Inc., of New York City, for erecting the Government fortifications at Manila Harbor, described and illustrated in the Engineering Record of Oct. 10, page 396, was tested at the Sandy Hook Proving Ground in connection with the mounting of guns and turret armor. This work called for the design of a reinforced-concrete pedestal under the mast, steel and timber grillages for carrying the counterweights at the feet of the stifflegs and the substitution of sills from the foot of the mast to the feet of the stifflegs. These sills were made of wood to lessen their cost, and to add to their salvage value when scrapped after the test.

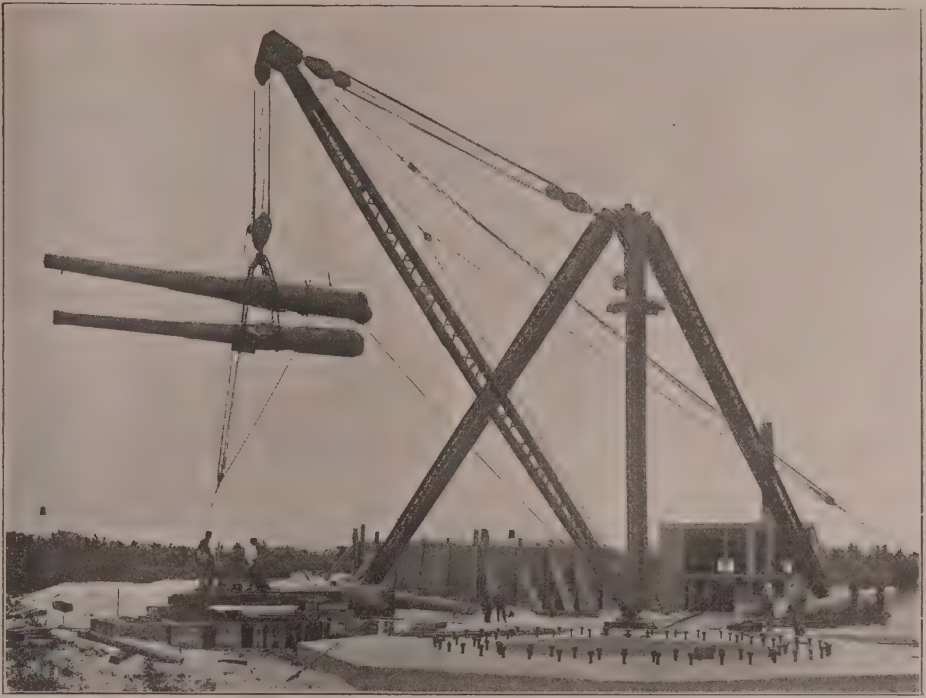
The riveted steel pedestal which received the cast-steel foot block of the mast was seated on a 12½ x 13-ft. reinforced-concrete pier 2 ft. high, with an extended footing 3½ ft. deep below the surface of the ground. Four 2-in. horizontal rods for each stiffleg were embedded in the pier concrete, with bent ends projecting down into the footing, and eighteen vertical anchor bolts were set with their upper ends projecting above the top of the pier to receive the pedestal. The upper surface of the pier was recessed 9 in. deep to give clearance for the sheaves receiving the lead lines which pass through the foot block.

WOODEN SILLS

The sills ,about 60 ft. long, were not quite duplicates, but varied about 1 ft. in length to correspond with the difference in length of the stifflegs. Each of them had a solid 24 x 24-in. cross-section made



DETAILS OF TEMPORARY WOODEN SILLS AND ANCHORAGES, WITH STEEL DETAILS



75-TON DERRICK LIFTING TEST LOAD

up of four full-length 12 x 12-in. yellow-pine timbers bolted together by vertical and horizontal pairs of ⅞-in. bolts about 5½ ft. apart. The bolts in each pair were 13 in. apart and between them the timbers were keyed together by staggered 3-in. pipes. At the mast end of the sill four pairs of horizontal angles were bolted to the vertical faces of the timbers to afford bearings for the nuts of screw rods embedded in the concrete base slab as already mentioned. At the opposite ends the vertical faces of the timbers were engaged between the temporary webs of the shoes for the stifflegs to which they were thoroughly bolted. Each sill weighed about 13,400 lb. Underneath the shoes the ends of the sills were reinforced by 24-in. I-beams 13½ ft. long, with vertical webs fitted between the timbers, and by 12 x 24-in. outside plates against which the connection bolts were screwed up tight.

VERTICAL REACTIONS

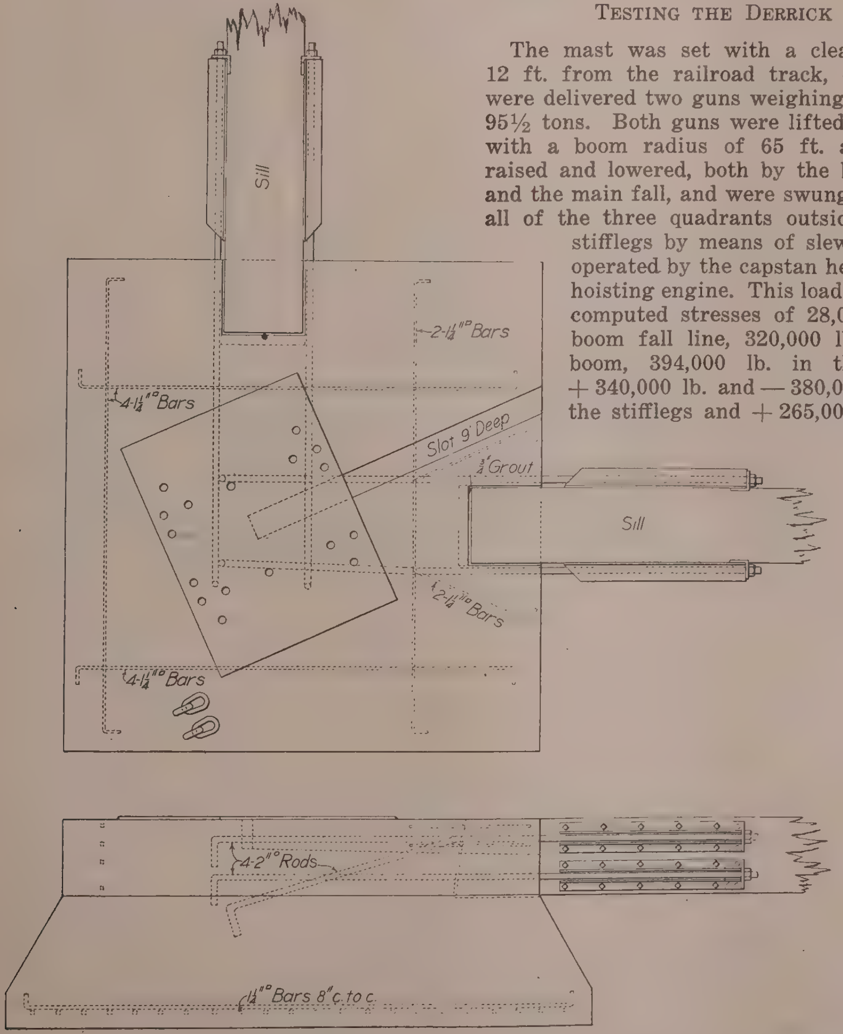
A computed reaction of 220,000 lb. at the foot of each stiffleg was provided for by a loaded grillage. The grillage consisted of a 12 x 14-ft. platform of 12 x 12-in. timbers transverse to the sill and bearing directly against it. They were seated on a pair of 15-in. distributing I-beams connected by four riveted diaphragms, and having on their lower flanges three pairs of saddle beams engaging three pairs of vertical screw rods anchoring the stiffleg shoes.

The side lines for swinging the loaded boom were anchored to I-shaped deadmen, made of three 12 x 12-in. timbers thoroughly spiked and braced together, buried 5 ft. deep in the sand, and loaded with a 5-ton counterweight on the surface of the ground.

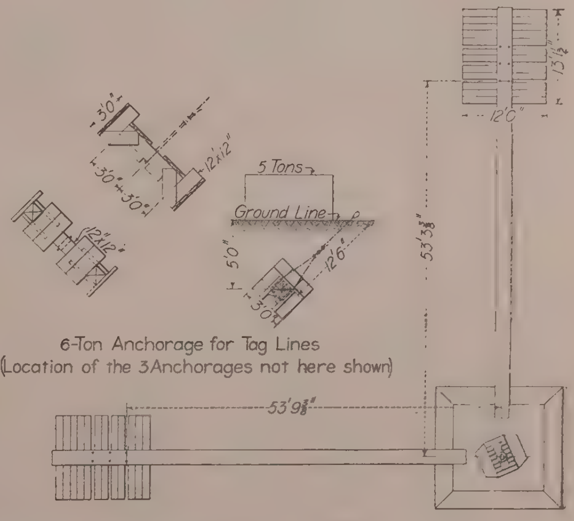
TESTING THE DERRICK

The mast was set with a clearance of 12 ft. from the railroad track, on which were delivered two guns weighing together 95½ tons. Both guns were lifted together with a boom radius of 65 ft. and were raised and lowered, both by the boom fall and the main fall, and were swung through all of the three quadrants outside of the stifflegs by means of slewing lines operated by the capstan head of the hoisting engine. This load produced computed stresses of 28,000 lb. in boom fall line, 320,000 lb. in the boom, 394,000 lb. in the mast, + 340,000 lb. and — 380,000 lb in the stifflegs and + 265,000 lb. and — 215,000 lb. in the sills, all of which were sustained without causing any visible vibrations or distortions of the derrick members.

ONE HUNDRED AND EIGHTY-THREE MEN were killed in the United States in and about quarries in 1913, according to a report just issued by the U. S. Bureau of Mines. The number of men employed in the quarry industry was 106,278, and the death rate per 1000 employed was 1.72, as compared with 1.88 in 1912, when the number killed was 213. The figures show that the principal hazards appear to be equally divided between explosives, haulage and falls of quarry material. Albert H. Fay, engineer of the bureau, who compiled the statistics, states that in France the death rate seldom exceeds 1, while in Great Britain, from 1895 to 1904, the rate was 1.09. He attributes the higher rate in the United States to less stringent regulation and less systematic inspection.



Footing for Mast



6-Ton Anchorage for Tag Lines
(Location of the 3 Anchorages not here shown)

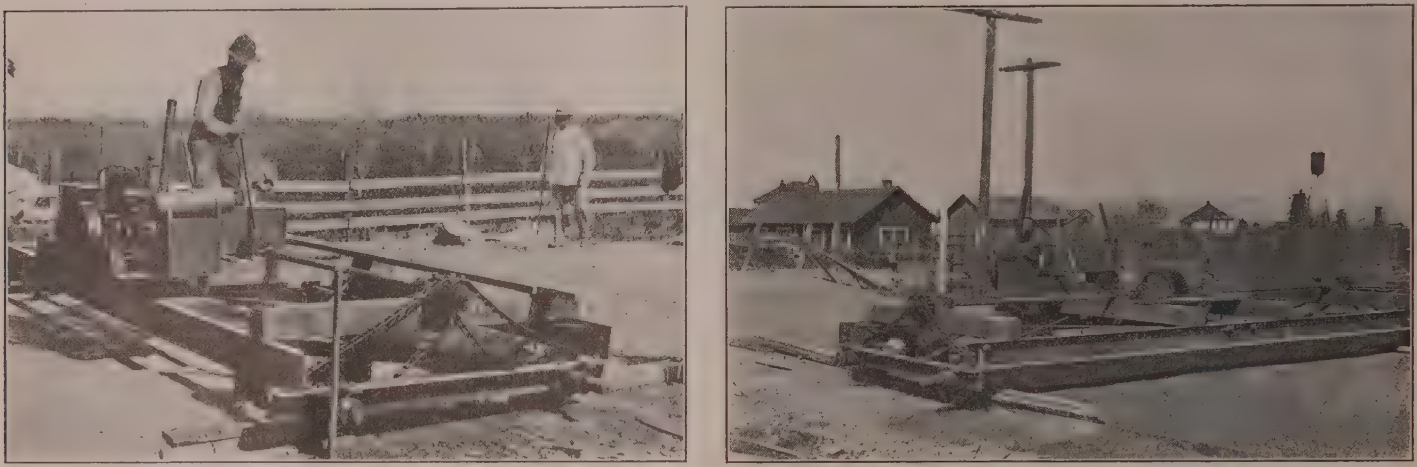
Derrick Sills

TEMPORARY SILLS, ANCHORAGES AND REINFORCED-CONCRETE MAST FOOTING

Rolling Concrete Pavement

Base and Surface of Oregon Roads Are Compacted by Special Iron Roller Designed by State Highway Engineer

IN laying concrete pavements on two highways in Oregon special attention has been given to securing a dense concrete mixture and compacting it as solidly as possible in place. It was decided that the latter effect could best be secured by the use of a heavy iron roller which could be passed over the concrete immediately after pouring, and which would take the place of hand tamping. A special roller was designed, and proved so satisfactory that three, like that shown in the accompanying illustrations, have been used by the highway commission during the past season.



TWO VIEWS OF SPECIAL 1½-TON ROLLER USED IN BUILDING 16-FOOT CONCRETE ROADS IN OREGON

Preparation for Rolling

The standard concrete pavement in Oregon is 5¾ in. thick at the edges for both the 16-ft and the 8-ft. pavement. The concrete is laid with a flat base. The crown is 1 in. on the wider and ¾ in. on the narrower pavement. On most of the work this year two grades of concrete have been used; the base course is rolled as soon as poured and then immediately covered with a 1½-in. top course of a very rich mix, which is also rolled. The materials in both mixtures are carefully graded so as to secure the maximum density, and from 5 to 10 per cent of hydrated lime is used in all batches of concrete.

The proportions for the base approximate one part of cement, two and one-half of fine aggregate and five of coarse aggregate, the latter not to exceed a dimension of 1½ in. The top course contains one part of cement to two of crushed stone screenings passing a ¾-in. ring and retained on a ⅛-in. ring. This gradation of the aggregate by actual mechanical analysis has given a concrete with an average density of approximately 166 lb. per cubic foot, which is 5 lb. less than the theoretical maximum density.

When the subgrade is properly prepared and rolled with a 10-ton roller, 6 x 8-in. timbers held down with 12-in. iron spikes are placed along both edges as forms, with their top surface true to the grade of the finished surface of the pavement, and the pouring then begins. These forms serve as the track for the special roller. The concrete is now spread upon the subgrade with the boom and turn-over bucket on the mixer. Expansion joints of heavy asphalted paper are placed every 30 ft., and a 10-ft. length of road is usually poured before rolling.

The commission has one roller for the 8-ft. pavement and two for the 16-ft. standard. The roll proper is of cast iron, weighing 1½ tons on the machine used for the wider pavement, and approximately half as much for that used on the narrower one. Motive power is provided on the larger type by a 12-hp two-cylinder gasoline engine of marine type, which drives both front and rear wheels, according to the position of the forward and reverse clutches. The rate of travel is about 1 mi. per hour.

The weight of the entire machine, except the roll proper, is carried on four flanged wheels which run on the 6 x 8-in. timber forms. When the top course is rolled a 1½-in. strip of wood is laid on the timber forms, or the roll is raised, by means of levers, 1½ in. above the ordinary working level. These levers make it possible for the machine to pass over the concrete surface with the roll raised above it.

Templet

An important feature of the design is the steel-plate templet which is suspended just ahead of the roll and 1 in. above its bottom. This templet strikes off the crest of the concrete ahead of the machine and permits the weight of the roll to compact no more and no less than the 1-in. "wave" of concrete ahead of it. When the rolling is finished the surface is so well compacted that walking over it leaves only light footprints not more than 1 in. deep. This illustrates the density obtained by the process. The wearing surface of the concrete is then floated in the usual manner by a man working from a "bridge" with a wood float.

The machine is handled by a single operator. The cost of operation, including wages, fuel, interest and depreciation, has been found to be about $4 per day. The machines originally cost about $700 each. Ten miles of concrete pavement 16-ft. wide and 4 mi. 8 ft. wide have been laid, as above described in the State of Oregon during 1914.

Henry Bowlby, State highway engineer of Oregon, developed the design of the roller and announces that he has applied for a patent on the machine, not for profit, but to protect for the benefit of the public the principle involved.

DAMAGE BY ELECTROLYSIS has been made the subject of a claim amounting to $678.27, presented by the water department of St. Paul, Minn., to the St. Paul City Railway Company.

Railroad Ice Houses

Notes from Committee Report Presented at Convention of American Railway Bridge and Building Association

RAILROADS are large consumers of ice, using it for fruit, meat and other perishable commodities as well as for supplying local needs. The design and construction of railroad ice houses are, therefore, subjects of prime importance, and are discussed in a committee report presented at the recent convention of the American Railway Bridge and Building Association at Los Angeles. These notes are taken from the report.

The problem of ice-house design is somewhat different from that encountered by cold-storage companies, that store perishable goods of considerable value. Yet the ice itself is of sufficient value to warrant the most careful construction at reasonable expense. The percentage of shrinkage in stored ice depends on the efficiency of the insulation of the building. It is not generally understood that wood is a better insulator than brick or concrete, and that the problem of insulation cannot be solved by merely changing from wood to brick or concrete. In any case insulation must be provided. At present the wood frame house is universally used.

It is most important absolutely to prevent the circulation of air within the house, for if any circulation occurs the warm air will continually come in contact with the ice and cause its rapid shrinkage. Still air, however, is the best insulation that can be found.

Floor Insulation

A feature that has been given slight consideration is the insulation of the floor. A majority of designers have thought it sufficient to level off the ground and place the ice directly on it, or on a surface covering of cinders, boards or concrete. Heavy losses due to shrinkage at the floor line indicate that the ground heat continually rises to the surface and melts the ice. In more recent houses the shrinkage from this cause has been largely reduced by providing air spaces between the ice and the ground, usually by placing joists and covering them with a slat floor for the support of the ice. The spaces are from 6 to 12 in. deep.

The wall foundations may follow the usual types of construction, with proper regard to insulation, especially where masonry foundations are used. A concrete foundation wall projecting 2 or 3 ft. above the ground line without inside insulation has been known to cause heavy losses by the transmission of heat through the walls to the air near the floor.

In porous soils the water from the melted ice is permitted to go directly into the ground, but in other soils drains must be installed. Special precautions must be taken to trap such drains so securely that no air currents can find their way into the house through them. The air entering through a 4-in. pipe a room containing 1000 tons of ice can easily melt all the ice in a single season.

Wall designs all follow the same general trend, with vertical studs from 6 to 12 in. wide covered on both sides with wood sheeting, building paper, etc. The best construction requires double sheeting inside and out, with waterproof building paper between the layers, the spaces between the sheeting from stud to stud being filled with insulating material.

INSULATING MATERIAL

It was formerly thought that air spaces afforded excellent insulation. It is now asserted, however, that air in a space 8 or 10 in. wide will be set in circulation by the air against the outer wall becoming warm and rising while that near the inner wall is cooler and falls. Such circulation rapidly transfers heat from the outer to the inner sheeting, and must be prevented—by cutting the spaces into smaller spaces with proper framing, or by filling them with porous insulating materials.

Various materials are used for this purpose; they are specially treated and prepared, principally from flax, cork and limestone. Flax is made up into blankets inclosed by sheets of waterproof paper. Cork is made up into cakes pressed and cemented together with asphaltum or other waterproof cement. Limestone is heated to 3500 deg. and when liquefied is blown into shreds so as to make a sort of rock wool inclosing a large percentage of air bubbles.

The two principal objections to wood-frame ice houses are the danger of fire and the decay of the timber. Safety against fire can be obtained by covering the exterior walls with stucco and expanded metal and the roof with a fireproof material. Openings where birds might enter and build nests should be covered with galvanized-iron mesh. Decay can be postponed many years by treating the timber, and there seems no good reason why treated timber should not be used.

Timber frames have been built inside the walls of brick and concrete houses and filled with insulating material. In most cases, however, the inside surfaces are completely covered with slabs made up of such porous materials as cork and board.

ROOFS

Steel roof trusses are seldom if ever used, on account of the rapid corrosion that would result from the dampness. The wood trusses are usually so built that the roof covering can be applied to the top chord and the ceiling to the bottom chord. The ceiling, like the walls, must be insulated. The attic space, varying in height from 3 to 10 ft., affords a good air insulator, and the roof keeps the direct rays of the sun from the ceiling. The walls must be tight enough to keep birds out, while there must be sufficient louvres, screened, to permit free circulation of air.

The greatest care must be taken with the connections of the walls with the foundations, ceiling and partitions in order that there may be no opening however small, through which air can enter directly into the ice chambers.

The doors are usually of ordinary refrigerator construction with several sections separated by air spaces, which are sometimes filled with insulating material. Great care must be taken in the connections so that no air can circulate between door and frame.

In the past it was universal practice to cover ice with sawdust and fill all crevices between cakes and against the walls. That practice has virtually ceased on account of the loss of ice in washing the sawdust off. It is necessary, however, to use some means of keeping the ice apart in order that the cakes will not melt together if shrinkage is rather rapid. Strips of board do not seem to be very effective, as they melt into the ice and permit the cakes to come together. Recent experiments have been made in the use of waterproof paper to separate the cakes. Materials that necessitate washing of the ice should be avoided.

PLATFORMS

The length and width of the platform for handling ice between cars and ice house depend on the requirements. When conveyors are not used and the ice is handled in buggies a 16-ft. platform will usually be found convenient, although narrower ones have been successfully operated. Where a comparatively small number of cars are iced short platforms accommodating from five to ten cars, are sometimes built in front of the house. Where there are many trains to be iced it is of considerable advantage to have a platform a full train length. In such cases continuous platform conveyors are advantageous. In some cases adjustable platforms are built adjoining the house, and continuous conveyors carry the ice to and from the house by adjustable inclines.

Many houses are built with no mechanical means for handling ice, and temporary hoists operated by horses or by hoisting engines are used. Such means are entirely inadequate at large houses, in the great majority of which vertical elevators and skips are used. The skips handle from 600 to 2000 lb. of ice per trip, and some make as many trips per minute, the floor and wiring of the skip being so adjusted that the skip stops and the ice automatically slides off when the proper level is reached. Such elevators will handle from 500 to 1000 tons per day into or out of the house.

Half Stone and Half Earth Highway

Narrow Macadam Way Laid Alongside Improved Earth Road at Monroeville, Indiana, for the Sake of Economy

FOR economy of construction and to retain the good qualities of an earth road during periods of good weather, many miles of half earth and half stone road have been built in Indiana, of which a 4-mi. stretch near Monroeville is a typical example. Bonds for the improvement, costing $4200 per mile, were issued by the township.

As shown in one of the photographs, the stone is laid 10 ft. wide between wood curbs to a depth of 12 in. There are three courses—5 in. of 2 to 3½-in. material, 4 in. of 1 to 2½-in. and 3 in. of ¼ to ¾-in. screenings.

Originally the road was of gravel, but this was plowed up with a 12-ton Huron road roller, which at the same time compacted the future subgrade of the earth portion of the road, offset hitches for the plow being made. The extra material was used to build up the 12-ft. earth road. Each course of stone and the subgrade were thoroughly rolled before applying the succeeding layer to a 3-in. crown.

LAYING STONE ROAD BETWEEN WOOD CURBS AT MONROEVILLE

PLOWING FOR STONE ROAD AND COMPACTING EARTH ROAD

Material shipped in from Middlepoint, Ohio, was hauled 2 mi. from Monroeville, or from 1 to 2 mi. from Dixon, Ohio. With from five to ten teams the road gang progressed 500 ft. per 10-hr. day.

The work was carried out under the direction of Ralph Guenther, county surveyor, by Ellison & Company, of Monroeville.

Concrete Highway Bridge Construction as Standardized by Iowa Commission

Structures Were Designed with Reference to Topographical Conditions and Uniform Plans and Specifications Prepared for Use Throughout the State

By C. B. McCULLOUGH
Designing Engineer, Iowa Highway Commission

THE conditions governing the design of ordinary highway bridge structures are so widely diversified that the statement is often made that to standardize such construction over a territory of any considerable extent is, if not impossible, at least a task involving a multiplicity of details that render it impracticable. The State of Iowa through her highway commission is endeavoring to prove the contrary to be true.

Iowa covers an area of slightly over 35,000,000 acres. Its general topography is that of a flat plain. With the exception of a very narrow strip along the northeastern border of the State, which still retains its original rugged topography, the entire State was at one time covered by the ice invasion. The glaciated area includes three principal drift sheets. Topographical conditions in these drift regions are sufficiently different from one another and from the unglaciated region as to affect greatly the bridge problems of the different parts of the State.

Three Topographical Divisions

The Kansan drift which occupies the entire lower portion of the State and the western edge of the upper portion is the oldest of the drift areas. Here we find the drainage lines well defined, the streams being carried in general through deeply cut ravines. Due to the age of the land a very complete oxidation has taken place for a considerable depth and a scarcity of concrete materials almost universally prevails. The foundation material is a typical glacial clay, the surface soil on the western slope being the typical Missouri Valley loess, which is notable because of its apparent stability in embankments and cuts at unusually steep side slopes.

In the Iowan drift the drainage lines are not so well defined, the streams being in general carried in comparatively shallow channels, which ofttimes overflow during periods of high water. Owing to the fact that the land is newer, we find deposits of concrete material scattered more or less frequently over the entire area. The subsoil is a blue clay with occasional outcroppings of rock. This last condition, however, would be classed as local rather than belonging to the drift area itself.

The youngest of the drift sheets is the Wisconsin, which lies west of the Iowan and is slightly larger in extent. In this area the drainage lines are very loosely defined. The topography comprises marshes, lakes and dry depressions which in time of high water become ponds and swamps. We find here the shallow drainage channels typical of the Iowan drift and a more or less plentiful deposit of concrete materials scattered along the stream lines and terminal hills. The subsoil is either a sandy clay or the so-called gumbo, very retentive and difficult of drainage.

For the varying conditions which have just been described, several types of standard superstructure were needed.

To meet the condition of scarcity of concrete materials found in the Kansan drift area required a relatively light and heavily reinforced structure in order that the cost of hauling might be reduced to a minimum. In this connection it was fortunate that the same agency, age, which produced the scarcity of concrete materials also operated to deepen the drainage channels and increase the available head-room. Thus the deck type of girder construction, using a relatively thin, deep girder, has proved an economical solution.

To meet the conditions found in the Wisconsin and Iowan drifts the multiple span slab and through-girder types were designed, these being less economical of material but more conservative of head-room. However, even in these last localities the deck-girder type of construction has proved the more economical wherever local conditions would permit its use. Thus the through-girder and slab types have been used in the Wisconsin and Iowan drift region only when the peculiar topography of this area rendered the use of the deck type impracticable.

To meet the conditions of the unglaciated topography of the northeastern section of the State, any of the above types may be used, as concrete material is plentiful and the saving of head-room is generally not a determining factor, although in general the natural rugged topography of this region necessitates the use of larger structures than in the more rolling portions of the State.

In connection with the standardizing of substructures it may be noted that in each of the drift areas the subsoil is a clay formation. Experience has taught us that once the foundations are carried well into this clay there is little advantage to be gained as regards increasing the bearing value in carrying the foundation deeper, the use of piling being in general a cheaper and more effective method of strengthening the foundation. The depth of foundation is then governed by the necessity for protection against scouring, which is in general greater with streams which are not yet cut to their base level. The width of abutment depends not alone on the bearing value of the soil, but is governed by one other consideration, the horizontal component of the retained back filling. This is, of course, more or less a function of the drainage and a comparison of the conditions in the different areas in this regard will favor the Kansan as against the gumbo formation of the northern drifts. By making adequate provision for drainage through the abutments and wings, however, this condition can be so governed that for purposes of standardization a uniform base width may be adopted for the entire State.

Types of Abutment

The cantilever type of abutment has been chosen for the general standard of the State, although to meet the conditions of scarcity of concrete material found in the Kansan drift area another type of abutment, the pedestal or integral approach span type, is being developed. In selecting the latter type of construction use was made of two of the main characteristics of the topography of this locality. One is that the streams are in general cut to their base level and the danger of undermining at the outer ends of the wings is much less than in the other drift areas. The other is the peculiar ability of the loess to stand at very steep natural slopes, which permits of relatively small, deep excavation work and probably reduces the active horizontal pressure against the abutment pedestal, thus giving an added factor of safety in the design.

The box type of culvert has proven in general the solution of the culvert problem over the entire State, with the exception of the very deep ravines and gulches, requiring an excessively high fill. Due to one of the peculiar properties of the arch, namely, that an increase in fill does not produce a corresponding increase in ring stress, this latter type of culvert has been used with economy where the high fill over a box would necessitate a slab of considerable thickness. Such a depth of fill would be exceptional for this State and for all ordinary purposes the box type will prove the economical one.

Operating under the new highway law, which makes it incumbent upon the State commission to furnish standard plans to the 99 county engineers of the State, the commission has, since April 9, 1913, when the new law went into effect, furnished to the different county officers over sixty different standard plans of the various sizes and types of bridge construction.

These were designed in connection with a set of standard specifications which are distributed as part of the standards. A brief synopsis of the principal material and loading requirements of these specifications follows:

Material Specifications

The concrete specified is a machine mix concrete from a standard batch machine, the mixtures being classified in five classes as follows:

Class A, used for all slab and girder work, and for all abutment work above footings, 1 part cement, 2 parts sand, 4 parts crushed stone or screened pebbles passing a 1½-in. screen.

Class B, used for footings, 1 part cement, 2½ parts sand, 5 parts crushed stone or screened pebbles passing a 2½-in. screen.

Class C, used for footings for gravity section abutments and piers, 1 part cement, 3 parts sand, 6 parts crushed stone or screened pebbles passing a 2½-in. screen.

Class D, used for thin section concrete work such as thin floors, slabs, etc., 1 part cement, 2 parts sand, 3½ parts crushed stone or screened pebbles passing a ¾-in. screen.

Hand-rail concrete, 1 part cement, 2½ parts screened sand.

The cement is to be measured as packed and to be of any standard brand conforming to the specifications of the American Society for Testing Materials (Aug. 16, 1909).

The sand specified must consist of clean, silicious grains, uniformly graded in size from the finest particles to a diameter passing a ¼-in. screen. It shall contain not more than 3 per cent of clay by actual dry weight. The apparent clay content determined by the water test is limited to 10 per cent.

The screened gravel shall be graded in size from ¼-in. material to the size denoted by the class requirements. Material such as clay, shale or distintegrated boulders is limited to 3 per cent by dry weight. The unscreened gravel shall conform to the same requirements as regards size, cleanness and quality as given for sand and screened gravel. The use of crusher run product is permitted in stone with the limitation that the sand content shall be reduced for any excess of "fines" in the stone to conform to the class requirements.

For reinforcing steel the standard specifications of the Association of American Steel Manufacturers, 1910 (revised in 1912), are used, with the additional limitation that all material shall be open-hearth steel of structural grade and rolled from new billet stock. All bars are to be provided with a mechanical bond by means of a deformed section of approved pattern.

LOADINGS

The different standard superstructure plans herein described were designed for the following loadings:

1. Dead loadings induced by the following unit weights of superimposed material:

Earth filling	120 lb. per cu. ft.
Concrete	150 lb. per cu. ft.
Brick masonry	150 lb. per cu. ft.
Timber (treated)	5 lb. per ft. b. m.
Timber (untreated)	3½ lb. per ft. b. m.

2. A uniformly distributed live load over floor and sidewalk surface of 100 lb. per square foot, or a concentrated live load consisting of a 15-ton traction engine whose dimensions are as follows:

Weight on rear axle	20,000 lb.
Weight on front axle	10,000 lb.
Distance between axles	11 ft.
Distance between rear wheels	6 ft.
Width of rear wheels	22 in.

Where the floor slab supporting this concentration is relatively thin, as in the deck girder floors, each of the rear wheels is assumed to distribute over an area 4 x 4 ft. Where the slab is 12 in. thick or over the lateral distribution is increased to 6 ft. for each wheel or 12 ft. for the entire rear axle load, and the longitudinal distribution is taken as 5 ft.

The culvert loadings are taken the same as the foregoing with the addition that below 1 ft. the wheel load concentration is assumed to distribute through the earth fill in four directions at the rate of ½ horizontal to 1 vertical.

The permissible stresses in material used are as follows:

Compression in concrete	600 lb. per sq. in.
Tension in concrete	None
Tension in reinforcing steel	16,000 lb. per sq. in.
Shear in concrete	100 lb. per sq. in.

Shear = V/bd, for reinforced section, where V = total shear and b and d are the breadth and effective depth of the concrete beam.

Bearing on ordinary soil foundation—2 ton per sq. ft.

Safe load on piling—(Engineering News formula).

(Where piling are used they shall be proportioned for the entire foundation load.)

The principal types of standards thus far distributed are the standard abutment designs, standard slab designs, standard deck and through-girder designs and standard culverts. These will be taken up in the order given.

STANDARD ABUTMENTS

In preparing designs for standard abutments, the question that logically assumes first place is this: Against what active horizontal earth pressure is it best in the interests of both safety and economy to design abutments? For a retaining wall with horizontal earth filling surface Rankine's formulæ for retaining walls leads to the expression

$$P = \frac{wh^2}{2} \times \frac{1 - \sin\varphi}{1 + \sin\varphi}$$

the only variable being φ, which is the natural slope, or slope at which the material is stable in embankments. For undrained material during periods of saturation this angle may assume a very small value, while for the Missouri Valley loess an angle as great as 45 to 50 deg. could, perhaps, be safely assumed. Using a value of 30 deg. as a mean between these two extreme conditions we find as a result of substitution in the formula a horizontal intensity of earth pressure equal to one-third of the vertical intensity. On the basis of the average weight of material used in this State as a back filling, this would give a pressure of about 40 lb. per square foot. On the other hand masonry walls with a base whose width is four-tenths of the total height have long been considered good engineering practice, and the large number of examples of construction such as this, which have stood for many years and are still apparently in first class condition, seem to warrant the adoption of the fluid pressure which will give as a result a wall of stability equivalent to a gravity section with a base width four-tenths of the height. This equivalent fluid pressure is from 20 to 25 lb. per square foot, depending upon the particular shape of the gravity section. Thus we have two assumptions as to active horizontal pressure differing by nearly 50 per cent.

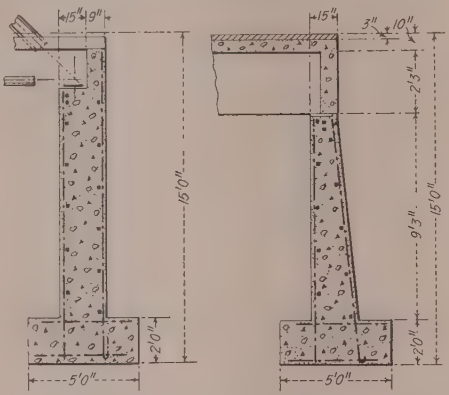


Fig. 1 Fig. 2

FIGS. 1 AND 2—SUBSTRUCTURES FOR STEEL SPANS AND SLAB AND GIRDER BRIDGES

In masonry construction these theories which apply to retaining walls could be applied with equal truth to abutments, but with reinforced concrete we can utilize another important stability factor, the weight of the wings, to reduce the section. The effect of these wings is obviously to shift the center of gravity of the entire mass toward the rear and thus reduce the eccentricity of pressure on the base.

With a view to striking a sensible average between the extreme different assumptions given above, the following general method was adopted for the design of the standard abutment structures. A base width of one-third the total height was first assumed and the abutment stem was designed to withstand stresses caused by a horizontal earth pressure of 40 lb. per square foot. Three different analyses of the pressure on the toe of foundation were made under the following assumptions:

Case 1. Taking into account the effect of the wings and using a horizontal earth pressure of 40 lb. per square foot.

Case 2. As a retaining wall, no account being taken of the stability due to the wings, using a horizontal earth pressure of 20 lb. per square foot.

Case 3. Same as Case 2, the horizontal earth pressure being taken as 40 lb. per square foot.

A measure of the difference in computed pressures for the different cases is shown in Table 1 for the 10 and 18-ft. heights.

TABLE 1.—DIFFERENCE IN COMPUTED PRESSURES ON TOE OF ABUTMENT FOUNDATION

Height of Abutment, Feet	Foundation Pressure		
	Case 1	Case 2	Case 3
10	2336	2796	5016
18	3175	3640	6840

Table 1 shows in a very marked degree the utility of the wings in reducing the foundation pressure. The mean value of these pressures being apparently a safe one and analysis for sliding and overturning being satisfactory, the dimensions assumed were adopted, after some minor modifications, for the standard base widths.

Figs. 1 and 2 show the details and dimensions for the abutment standards. These have been designed for use as substructures for both steel and concrete bridges. The wings have been turned out at an angle of 45 deg. with the roadway, this being the theoretical angle giving the minimum length of wing. There is a notation on the plan that this angle can be changed slightly to suit the local conditions, which would operate to modify the stresses in the abutment base, but any such change would be so small as to be within the limits of accuracy of the analysis.

The standard roadway for main county roads is 26 ft. wide between shoulders and the wings have been carried level and surmounted with a hand rail out to a point sufficient to give a clear approach roadway of this dimension.

WING WALLS AND REINFORCEMENT

To meet varying conditions as to stream cutting the wings have been designed in two lengths. The maximum wings are for use where the waterway occupies the entire opening and where protection against flooding and scouring is particularly necessary. The minimum wings are for use over streams which are cut to their base level and for the many locations in which we find a narrow berm between the edge of the bank and the face of abutment. In order to utilize the entire weight of the wings reinforcing bars are placed in the abutment stem near the upper surface and carried continuously through the wings, the splicing occurring at the center of the abutment body. These bars are sufficiently strong to lift the entire weight of wing and superimposed fill about an axis perpendicular to the general direction of the wings at their junction with the abutment body.

More or less difficulty has been experienced in the construction of abutments of this type with a tendency to the formation of vertical cracks on the outside at the corner of wing and abutment. To counteract such tendency, horizontal reinforcing bars are placed on the outside abutment face and carried around 5 ft. into the wings. As a framework upon which to build these horizontal bars and also to counteract any tendency toward the formation of horizontal cracks in the front face due to the clogging of an expansion joint, vertical bars in the front face have been used. These bars constitute a secondary system of reinforcing, being of a lighter section than the primary system in the back face of the abutment and wing.

In order to order reinforcing metal economically a diagram showing the method of cutting the wing bars is a part of the standard abutment plan.

Theoretically the maximum efficiency of the base can be obtained when the distance from the front edge to the rear of the stem is made about one-third the total width of the base. This would mean that for maximum economy the entire projection of the footing should be at the rear. While this is true for theoretical economy, it is ofttimes the case that considerable saving can be effected in excavation by shifting the footing a little toward the stream bed. To accommodate these conditions and to secure symmetry the footing has been so placed that the front and rear projections are equal.

SLAB DESIGNS

There is very little to be said concerning the standards for slab design. The floors are designed as simple beams under the loadings previously given, the main reinforcing bars being bent up to take the diagonal tension at the points where their section is no longer needed for moment. All longitudinal bars are fastened by means of short half hooks to a transverse spacing bar at the end of the span. The wiring of these two bars makes of the system a rigid frame and aids in holding the bars in place.

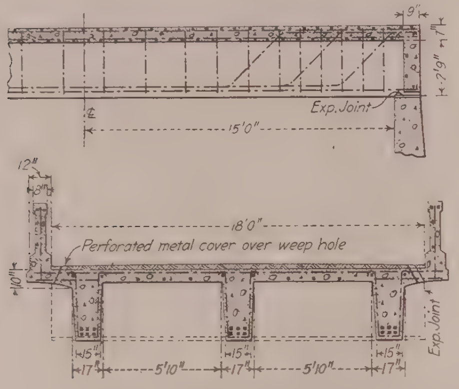


FIG. 3—STANDARD DECK GIRDER

To provide an expansion joint that would be effectually hidden from view, it was necessary that the outer portion of the slab width be cantilevered from the main body as the expansion joint cuts away the abutment support. To effect this, short bars are placed in the top of the slab.

DECK GIRDERS

The deep and narrow supporting girders which are the distinct feature of these designs act as simple beams for bending and shearing stresses and the floor which they support is designed both as a fixed and continuous beam, being proportioned to resist maximum stresses caused by either method of analysis.

To retain the fill at the ends of the span and at the same time to avoid a complicated parapet wall on the abutment a curtain wall has been designed integral with the floor and girder stems as shown in Fig. 3, and separated from the bridge seat by means of an open expansion joint. The expansion joints under the girder stems are sliding steel plates anchored into the body of both substructure and superstructure, while those in the hand rail, as in the case of the slab design, are open joints so located as to be effectually hidden from view.

The comparison of the quantities of concrete in the last two designs will show a marked economy in favor of the latter type of construction, although the actual saving in cost is not as great as apparently indicated by the quantities, due to the extra form work required in the girder type. On both the girder and slab has been placed a note regarding the proportioning of wing lengths. This note is another direct attempt to make these standards sufficiently elastic to meet the varying topography of the State.

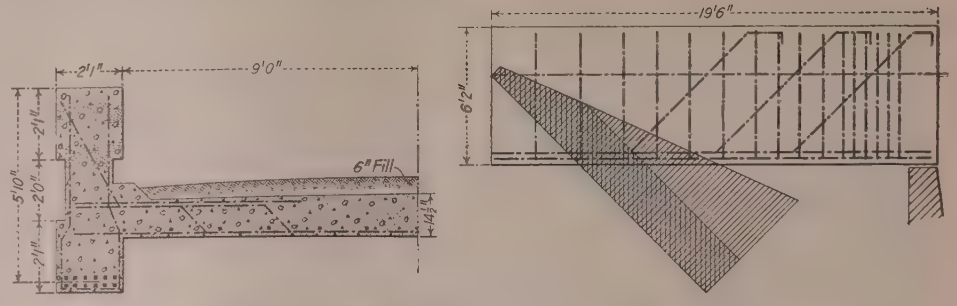


FIG. 4—THROUGH GIRDER DETAILS AND DIAGONAL TENSION DIAGRAM

Foundations are all carried a distance of 4 ft. below the bed of the stream, which comes as near meeting the actual foundation conditions of the State as any fixed dimension. A notation concerning increase in this foundation depth and the use of piling renders these designs sufficiently elastic for standard purposes.

THROUGH GIRDERS

The through-girder designs (Fig. 4) are an attempt to meet the low head-room conditions found in the northern drift areas and can be justified only for this reason. The girders themselves are designed as simple beams and the floor as partially fixed, the point of contraflexure being arbitrarily assumed as 1 ft. from the junction of girder and floor. This is in accordance with the latest experimental data concerning the action of these suspended floors.

A comparison of the quantities in the through and deck type is given in Table 2; this shows a marked economy in favor of the deck type.

CULVERTS

The standardization of the box culvert (Fig. 5) was a comparatively easy matter.

TABLE 2.—COMPARATIVE QUANTITIES FOR THROUGH-GIRDER AND DECK-GIRDER TYPES

	Cu. Yd. Concrete		Lb. Reinf. Steel	
Span, Feet	Through	Deck	Through	Deck
24	33.5	25.6	4520	4000
26	37.5	28.1	5024	4312
28	41.8	30.9	5568	4791
30	46.5	34.3	6198	5188
32	51.5	36.7	6697	5801
34	56.9	40.6	7372	6413
36	62.6	43.5	7972	6883
38	68.3	46.8	8570	7386
40	74.3	50.9	9416	8067

For the shorter spans wings parallel with the roadway were used for the low fills, these being carried up above the grade line sufficiently to provide a low guard rail which, for this size opening, was considered both safe and economical.

With the larger spans (8 ft. and more) the straight wings to retain the fill efficiently assume such a length and height as to be very costly in comparison with the total expenditure usually allowed for such a culvert. To meet this condition, and also to provide a protection for the roadway where the fill was low, wings at 45 deg. in combination with a coped extension of wing and head wall, to form a low guard rail, have been adopted.

While the culvert slabs were figured as simple beams, they are essentially fixed beams and consequently a vertical load will induce negative stresses which can be resisted only by reinforcing around the top corners. To do this cheaply the corner bar shown in the drawings of the small span culverts has proven acceptable.

Due to the fact that a great deal of this culvert work will not be done under the supervision of an engineer or skilled foreman, each plan has been supplemented by a data sheet giving diagrams for the cutting and bending of bars, and staking out of the neat masonry lines.

In this discussion no mention has been made of the arch type of structure. In explanation of this attention is called to the fact that this discussion has to deal with standard designs only, and that these standards are for spans whose maximum length is but 40 or 45 ft. It is quite probable that for spans as low as this the arch type will never be widely used in this State, although for the larger structures

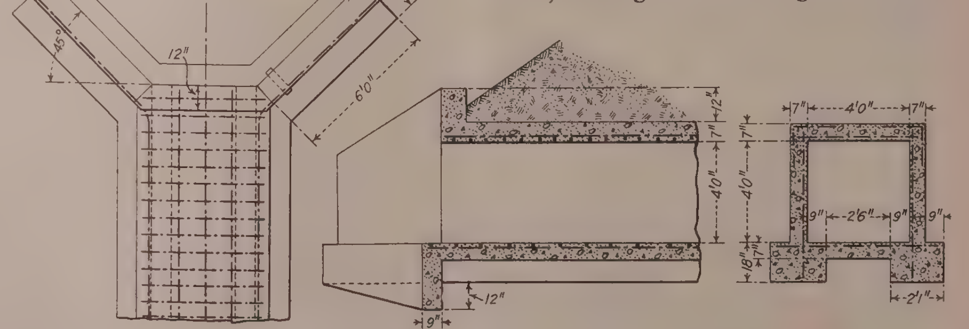


FIG. 5—STANDARD DESIGN FOR CONCRETE BOX CULVERT

and individual designs it is being used successfully in a great many locations.

SPECIAL ABUTMENT

The statement was made in the preceding paragraph that to meet the conditions found in the Kansan drift area a new type of abutment was being designed. A view of a special design of this type, which has not been in use sufficiently long to standardize, is shown in Fig. 6. The essential feature of this construction is the use of a series of four high pedestals. By using a very heavy and stiff strut (which acts also as a floorbeam) between the two main pedestals, the shore bent is rendered safe against all drifting and floating débris. This is especially true for the locations for which this type is designed, since in general these pedestals will stand outside the permanent bank line on the old flood plain of the stream.

The use of approach span girders integral with the pedestals transforms the front and rear bent, by the introduction of a rigid shear member, into a unit structure wherein the front pedestal footings are enabled to act as compressive flange area and the rear pedestal footings as tensile flange area. Thus the rear pedestal compression is reduced by the flange tension due to the horizontal earth pressure and the bearing on the same very materially decreased. These rear pedestals may then be carried to a very much less depth than the front ones, particularly as the danger of overflow and consequent undermining in this drift region is slight.

By letting the material of the back-filling take its natural slope between pedestals the only eccentricity on the main pedestals is that transmitted through the approach span girders, and this can be efficiently taken care of by the use of piling in cases where the bearing value of the earth itself is not sufficient.

The whole construction is floored to act as an approach span and the aesthetic possibilities of the design are great.

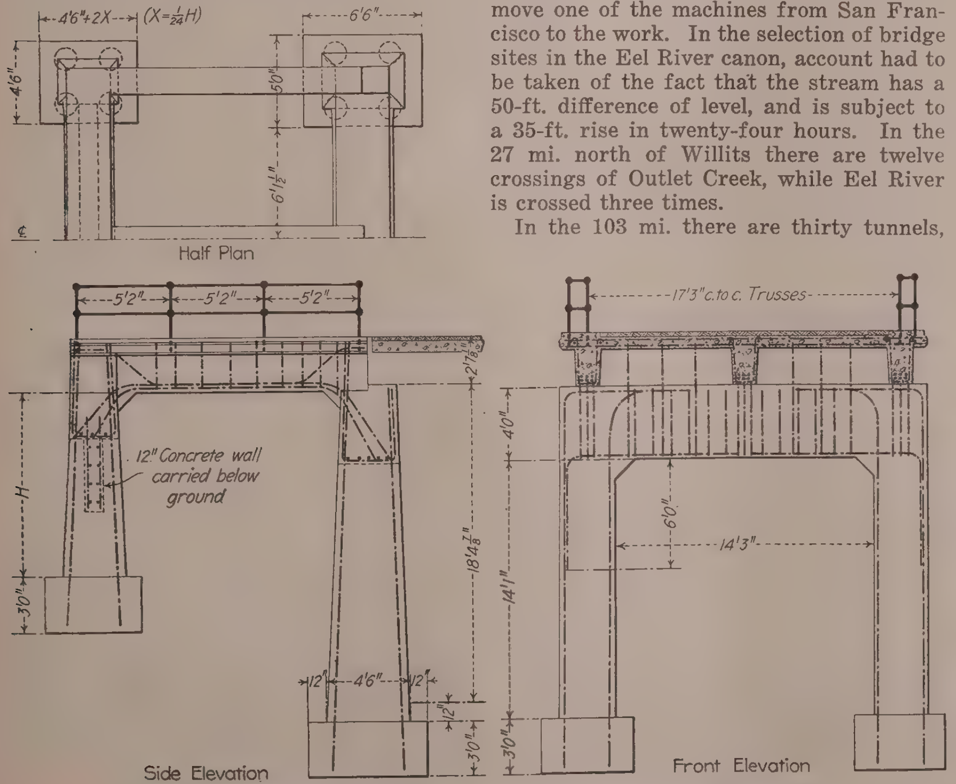


FIG. 6—CONCRETE FLOOR AND ABUTMENTS FOR 60-FOOT BRIDGE

For the high openings found in the Kansan drift region an economy as great as 50 per cent may result from the use of this type of construction as against the cantilevered type. Where material is cheaper the extra form-work incident to this type of design will cut down the economy, and the danger of undermining the rear pedestals in the younger drift regions will render its use extremely impractiable.

Completion of Northwestern Pacific Railroad

Last Gap in Line from San Francisco to Eureka, Cal., Is Closed, Giving Latter City Its First Through Rail Connection

As stated in the "Current News" of last week, the first through train over the Northwestern Pacific Railroad from San Francisco to Eureka, Cal., was run Oct. 23. The Northwestern Pacific Railroad Company was formed in January, 1907, under the direction of the Santa Fé and Southern Pacific companies for the purpose of combining and operating as a single system the eight railroads, with a total length of about 500 mi., owned by the two parent companies in the coast counties of northern California. These roads included lines from San Francisco north and from Eureka south, but a gap of 103 mi. between Willits and Shively prevented through traffic. Eureka has a population of about 14,000, is 286 mi. from San Francisco, and was said to be the largest city in the United States without through railroad connections.

FEATURES OF THE NEW CONSTRUCTION

The work of closing the 103-mi. gap was described in the Engineering Record of Dec. 13, 1913, page 664. It involved transportation problems and very heavy construction, and is estimated to have cost $120,000 per mile. Three steam shovels and six small locomotives were taken in, via Eureka, by steamer and auto truck under conditions that made it cost about $2,000 to move one of the machines from San Francisco to the work. In the selection of bridge sites in the Eel River canon, account had to be taken of the fact that the stream has a 50-ft. difference of level, and is subject to a 35-ft. rise in twenty-four hours. In the 27 mi. north of Willits there are twelve crossings of Outlet Creek, while Eel River is crossed three times.

In the 103 mi. there are thirty tunnels, aggregating 15,600 ft., the longest of which is 4335 ft. in length. Due to being cut off from the completed road by an unbridged crossing, the longest tunnel was completed and lined before the rails were laid to it. This was facilitated by the erection of a mill close at hand which sawed all the timber required.

BRIDGES

All bridges are of steel on concrete piers, and in some cases the foundations are specially anchored and reinforced to resist the impact of the very large trees carried down by floods. The standard roadbed construction of the Harriman system has been adopted, with maximum grades and curves of 0.7 per cent and 10 deg. respectively, the latter being used only where they afforded a considerable saving over the normal standard of 8-deg. curves.

Work on the new road has been rushed throughout the summer months, day and night shifts being used much of the time, as construction in winter is extremely costly on account of the effect of the heavy rains on the soft, shifting earth. Much satisfaction has been expressed over the completion of the road before the rainy season, and it is now expected to maintain service throughout the winter.

W. C. Edes, now a member of the Alaskan Engineering Commission, which has been making surveys for Government railways in Alaska, organized and directed the engineering work as chief engineer of the Northwestern Pacific Railroad.

Contractors' Bonds in Hudson County, New Jersey

Written Consent of Two Responsible Real-Estate Owners in County to Become Surety in Amount Fixed Will Be Accepted

The Hudson County Board of Freeholders made a ruling Oct. 8 eliminating the necessity for successful contractors on county work to provide surety-company bonds for faithful execution. Following investigations, the board decides that such practice, which has been strictly in force in years past, has not only resulted in increasing the cost of public work through adding the amount of the premium for such bonds to the amount of the particular bid, but has excluded from the field a number of possible bidders who do not desire to go to the expense of procuring surety-company bonds. The board holds that through the practice of retaining a sum of money upon public contracts as the work progresses the county is amply protected even without any bond, and that in the plan now determined it will be fully secured by the giving of bonds of responsible owners of local real estate.

Hereafter persons bidding on public work for the board shall have the option of furnishing a bond in legal form of an authorized surety company, or a certified check, or the consent in writing of two responsible real-estate owners of Hudson County that they will become surety in the amount fixed for the faithful performance of the particular contract. Such bond is to be canceled and certified check returned upon payment of the retained percentage of the work done under the contract awarded. When a bond other than a surety bond is given, the form is to be approved by the county counsel, and the amount of the surety approved by the board.

Eccentric Rivet Connections

Rivets Take Loads in Proportion to Distances From Center of Rotation Established by Equilibrium of Forces

SEVERAL methods are in common use for calculating the load each individual rivet takes when a riveted connection is eccentrically loaded or must resist moments. In such a case it is important to determine which rivets take the largest portion of the load in order that over-stressing may be guarded against. The following method of determining the loads has been developed by Prof. P. Gullander, of the Chalmers' University of Technology, at Gothenburg, Sweden.

The method is based on the assumptions that (1) the medium through which the load is transferred by means of the rivets is non-elastic and (2) the load on each individual rivet is in proportion to the movements of the medium due to the external load.

If the steel plate in Fig. 1 is connected to another part of a steel structure by a number of rivets N_1, N_2, N_3, etc., placed in any order, and if R is the resultant of the load to be transferred by the rivets, the plate will have a tendency to rotate around an axis C, perpendicular to its surface. Consequently the stresses to be taken by the rivets will be in proportion to the distances from this center of rotation. In the figure, the system of axes is so located that the x-axis is perpendicular to the resultant R; N, the load to be taken by a rivet having the co-ordinates x and y; u, the distance from this rivet to the center C; φ, the angle formed by this line with the x-axis; and x and y the co-ordinates for C.

Equilibrium must exist between the external load on the plate and the bearing pressures against the plate in the rivet holes. The projection equations along the x and y axis, therefore, read

$$\Sigma N \sin \varphi = o \text{ and } \Sigma N \cos \varphi = R$$

and the moment equation in respect to o reads

$$\Sigma N \cos \varphi x + \Sigma \sin \varphi y = Rr$$

According to assumption (2)

$$N = ku \qquad (1)$$

where k is a constant. Furthermore, from the figure it is apparent that

$\sin \varphi = (y - y_o)/u$ and $\cos \varphi = (x - x_o)/u$

The equations given above can, therefore, be written

$$k(\Sigma y - \Sigma y_o) = o$$
$$k(\Sigma x - \Sigma x_o) = R$$

and

$$k(\Sigma x^2 - x_o \Sigma x) + k(\Sigma y^2 - y_o \Sigma y) = Rr$$

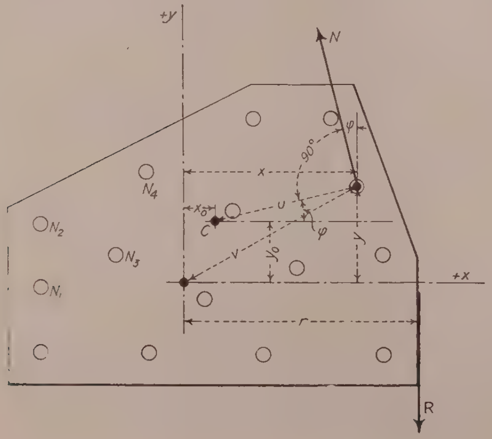


Fig. 1

These equations, however, can be materially simplified by a more advantageous selection of the origin of co-ordinates. If, therefore, the rivets are considered as being equally heavy particles with the mass m each, and their distances to any selected axis are a_1, a_2, a_3, etc., and a is the distance from the center of gravity of the group to this axis, the following equilibrium equation can be written

$$a_o \Sigma m = ma_1 + ma_2 + ma_3 + \text{etc.}$$

The distances a_1, a_2, a_3, etc., will be positive or negative according to their location with reference to the axis. If the number of the rivets is n

$$a_o = (a_1 + a_2 + a_3 + \text{etc.})/n = \Sigma a/n \qquad (2)$$

For an axis through the center of gravity

$$\Sigma a = o$$

Consequently, it is possible to select the axes x and y so that

$$\Sigma x = o \text{ and } \Sigma y = o \qquad (3)$$

and the point o can, therefore, be considered as the center of the group of rivets.

With this location of the axes the equations can be reduced to

$$kny_o = o$$
$$-knx_o = R$$

and

$$k(\Sigma x^2 + \Sigma y^2) = Rr$$

As $\Sigma x^2 + \Sigma y^2 = I$ the last equation can be written $k = Rr/I$ and the two others become

$$y_o = o \text{ and } x_o = -I/nr \qquad (4)$$

Introducing the value of k, equation (1) can be written

$$N = Rru/I \qquad (5)$$

By means of equations (4) and (5) the loads on the rivets can be determined as soon as R is known. From equation (4), it is apparent that the center of rotation C always will lie on the x-axis and on the opposite side of the origin from R. If v is the distance of any rivet in respect to o $x^2 + y^2 = v^2$ and consequently

$$I = \Sigma x^2 + \Sigma y^2 = \Sigma v^2$$

and I can, therefore, be called the moment of inertia of the rivet group in respect to the origin o. If in equation (4) $r = o$ the second equation becomes $x_o = -\infty$, which indicates that if the resultant R passes through the center of the group, the center of rotation C will be located at an infinite distance. The movement of the plate will then be parallel with R, and all rivets will take equal loads, in accordance with assumption (1), and

$$N = R/n$$

For $r = \infty$, the value $x_o = o$, which shows that if R acts at an infinite distance the center of rotation C lies in the center of the rivet group.

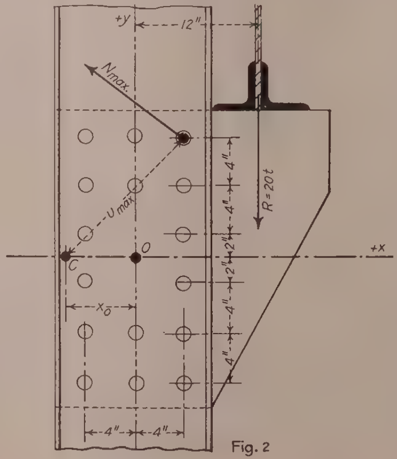


Fig. 2

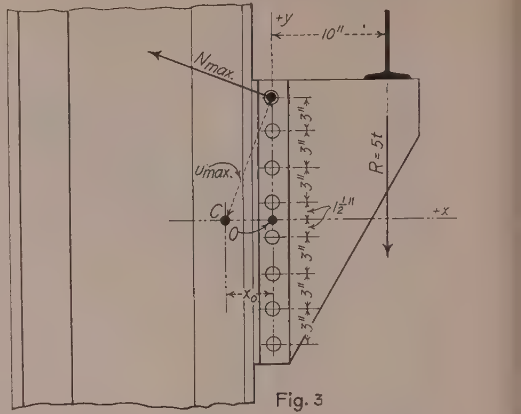


Fig. 3

In many cases it is impossible to reduce all the loads to only one resultant R. In such a case a couple acting on the group must be considered. The moment of such a couple can be written $M = Rr$, and the equilibrium equations are

$$\Sigma N \cos \varphi = o$$
$$\Sigma N \sin \varphi = o$$

and

$$\Sigma N \cos \varphi x + \Sigma N \sin \varphi y = Rr,$$

which, treated like the equations above, *give* $x_o = o$; $y_o = o$ and $N = Rru/I$. This proves that the center of rotation C lies in the center of the rivet group. In all other respects the calculation follows the same formulæ as before, but where Rr is the moment of the couple with reference to the center of the rivet group.

EXAMPLE I

A crane girder with a maximum reaction of 20 tons is to be supported on columns by brackets, as shown in Fig. 2. From the figure, the moment of inertia of the rivet group can be written

$$I = \Sigma x^2 + \Sigma y^2 = 12 \times 4^2 + 4 \times 2^2$$
$$+ 6 \times 6^2 + 6 \times 10^2 = 1024 \text{ inch.}^2$$

It is also apparent from the figure that $n = 16$ and $r = 12$ in. Consequently

$$x_o = -I/nr = -1024/16 \times 12$$
$$= -5.34 \text{ in.,}$$

which locates the center of rotation. As it is assumed that the rivets take loads in proportion to their distances from this center, the rivets farthest away will take the greatest proportion. Since, therefore,

$$u_{max} = \sqrt{10^2 + (4 + 5.34)^2} = 13.7 \text{ in.}$$

the load on that rivet will be

$$N = Rru_{max}/I = 20 \times 12 \times 13.7/1024$$
$$= 3.21 \text{ tons.}$$

EXAMPLE II

A bracket supporting the girder for a light crane is to be fastened to an existing column as shown in Fig. 3. From the figure the moment of inertia of the rivet group can be written

$$I = \Sigma x^2 + \Sigma y^2 = 2\ (10.5^2 + 7.5^2 +$$
$$4.5^2 + 1.5^2) = 378 \text{ inch}^2$$

because $\Sigma x^2 = 0$, the y-axis going through all the rivets. In this case $n = 8$ and $r = 10$ in. Consequently

$x_0 = -I/nr = -378/8 \times 10 = -4.73$ in.

which locates the center of rotation. The distance to the farthest rivet is

$$u_{max} = \sqrt{10.5^2 + 4.73^2} = 11.5 \text{ in.}$$

and the load on that rivet is

$N = Rru_{max}/I = 5 \times 10 \times 11.5/3.78 = 1.52$ tons.

Common Deficiencies in Public Works Reports —How to Correct Them

Hints on Improvement in Character of Material Used in Official Documents and Suggestions for Better Mechanical Make-up and Typographical Appearance

By A. N. JOHNSON
Bureau of Municipal Research, New York City

A STUDY of the public works reports of different cities discloses a wide variety of treatment and make-up, from the bulky volume with more than a thousand pages to a collection of tables that require a cipher code for their interpretation. It is evident that one or the other, or both of these presentations, must be wrong. They indicate a lack of conception as to the purpose of a public works report.

To be successful it is evident that the purpose of a report—to give citizens information as to the expenditure of public money for public works—must be kept clearly in mind. If the citizen body were composed of those having but a single interest, or if all could be interested in a similar manner, the preparation of such a report would be simplified. But a diversity of interests must be recognized and the information presented so as to satisfy different requirements, for it is clear that if the manner of presenting the information is such that it cannot be understood by the audience to whom it is addressed, then the report will fail of its chief purpose. It is therefore necessary, first, to analyze the various requirements of the readers of public works reports.

WHO READS PUBLIC WORKS REPORTS?

It will be admitted that these requirements are dependent upon the character of the audience to be addressed. In general the citizen body comprising the audience of a public works report may be divided into three main classes. In the first class are those citizens who have an interest in the activities of their community, but who wish only general information. This class constitutes numerically by far the largest portion of the audience. The second class is composed of citizens interested in a more detailed financial study of the city's activities, such as administrative officials, members of civic organizations, and a few others who would study a report closely. The third class, interested in technical matters, is made up chiefly of engineers within the city and engineers in other cities.

Public works reports in the past have, in general, recognized this division of interest, but seldom has any public works report been compiled with these three distinctions clearly in mind. The result has been that some reports are especially good in a general way, giving matters of general interest but lacking details that are of value to the student of municipal affairs. Other reports give only a mass of statistical detail that has little meaning and less interest to the average reader.

CREATING INTEREST THROUGH PRESS

It will be recognized that a most important function of a report is to command as much general interest among the citizen body as possible. Usually the reports, necessarily limited in number, will reach the hands of but few, and if the contact of the citizens with the report itself were the only means for them to gain information little would be known as to the activities of the city. The channel through which information must come is the newspapers. If, therefore, the information for the general reader is to be in proper shape, a public works report should contain a clear, concise, general review, free from technical language and confusing detail, occupying space not to exceed three or four newspaper columns. Suitable headings, and subheadings should be used throughout the report.

This portion of the report should constitute the opening chapter, presumably written by the administrative official in charge of the public works of the city. Information prepared in this manner would then be available in convenient form to be excerpted bodily by newspapers and thus relieve newspaper men of the necessity of reviewing the whole report. In doing this there is a possibility of missing essential features and dwelling at length on unimportant details, for it must be assumed that the head of a public works department must know the relative importance of the activities of his work better than any one else.

Aside from a general review of the entire public works of a city, the report of each bureau, in turn, should have an opening chapter outlining the activities of the particular bureau but entering somewhat more into detail than would be practicable in the general outline, at the same time being free from technical language and confusing tabular matter. Thus it would be possible, aside from a general story of the public works department as a whole, to obtain special stories of each division or bureau of the department.

To compile these portions of the report will require more care and judgment than any other part if the relative importance of the various activities is to be presented to the public so that a true perspective of the whole may be had. At times, with public interest centered on some special work, it will be necessary to describe in greater detail and length such a feature than would ordinarily be required. Again the necessity for certain improvements which are foreseen by the officials and not realized by the public in general may require special emphasis.

The information desired by the second and third classes of readers, as previously outlined, will necessarily overlap and it would be impracticable to divide a public works report or portions of the report into two divisions for the primary purpose of supplying separately for each of these classes the information they would require. It will be sufficient in compiling the report that the information these readers seek be presented in logical sequence and as fully as possible.

A tabular arrangement of facts and statistical data should be employed, but each table should state clearly just what it is and make unnecessary a study of the text to explain it. Statistics of expenditures and quantities of work done and costs of work are useful only from a comparative standpoint, so that tables showing only the results for a single year are of little value. Such tables should give data extending over a period of years and thus make a comparison possible.

Diagrams frequently give the reader a better comprehension of certain facts than can be done by tables and should be freely used. But, as with the tables, each diagram should be lettered so that with its title its meaning is self-contained.

TYPOGRAPHICAL APPEARANCE

The readability of a report depends in no small degree on its typographical appearance. The casual reader often avoids the perusal of a report because of its uninteresting appearance. The use of fine type, closely leaded, no suggestive headlines to break up the solid mass of text, few or no cuts to attract the eye, all combine to produce such an effect.

A report to be readable should be in clear, good-sized type on a convenient sized page. Frequent headings in larger sized type should be used, while chapter headings would be distinguished by still larger and bolder faced type. It is recommended that the body of the report should be of clear-faced, ten-point, Roman type, and well spaced, averaging about five and one-half lines of print to the inch. The size of forms or printed portion of a page should be 4 to 4½ in. in width and 7 in. high. There should be left a margin not less than ¾ in. on all sides, while 1 in. margin is better.

Cuts, to be of value, should be clear, made from good photographs, printed on highly calendered paper and of sufficiently fine line so that detail will not be lost. Where paper of a good quality is used for the cuts the screens used in the photo-engraving work should have at least 133 lines and may have 150 lines to the inch. In either case ink of good quality is necessary. Full size page cuts will be found far more satisfactory than reduced sizes, crowded two or three on a page. Where cuts are used they should be selected to bring out clearly the point desired so that one may look at the picture, read its title, and get the meaning without necessarily referring to the text. In some classes of work it is well to arrange a series of cuts that will tell the complete story of a process or construction as the case may be.

REPRODUCING DIAGRAMS

Diagrams to be useful must be easily readable. As a rule, diagrams are reduced from larger drawings, which will not stand much reduction because the usual lettering upon them, when reduced, will be too small to be clearly read. It is generally desirable to redraw diagrams that are to be reduced, exaggerating the lettering so that when reduced it may still be of a size that will be easily read. Bolder lines should be used and conventional detail exaggerated so that there may be no mass of lines which, when reduced, will print with a muddy effect.

Inserts for tables should be avoided where possible. They spoil the appearance of a report, are disagreeable to use and generally become torn and detached from the report itself. However, their use is sometimes imperative, and where necessary care should be taken that the inserts all are placed in the report to face the same way. For those tables that must be compared with the text, it is desirable that, when unfolded, there should be a blank strip left at the margin sufficiently wide so that the printed table may appear to one side entirely clear of the page. This, perhaps, applies more particularly to tables that would appear in textbooks than to most tabular statements that would be found in a public works report. Tables may be printed in much finer type than the body of the text, the size of the type being determined by the extent of the table. It is not advisable, however, to use less than six-point type.

Appendices may be set up closely leaded in eight or even six-point type. Six-point type with lines spaced with two points of lead will be found more easily read than eight-point type not leaded.

BINDING

Few care to keep in a library a paper-bound book. If, therefore, the contents of public works reports are worth preserving it is necessary that they be put in such shape as to invite their retention on bookshelves in private or public libraries. At least a portion of the number of reports issued should be bound in reasonably durable manner. When it is possible, volumes exceeding 600 pages should be avoided. Where the mass of material that must be presented makes larger volumes necessary, it had better be divided and issued in separate, smaller volumes.

WHY PUBLISH TECHNICAL INFORMATION?

The questions may be raised by many, "Why should a public works report contain information other than that which interests the general public?" Why, for instance, should technical information, understood and available to only a comparatively few individuals, be prepared and printed at public expense? The answer to this criticism is that progress is constantly being made in municipal engineering work. Conditions change that require different methods of treatment, new processes are evolved and new materials come into use. Some of these methods and materials are more successful than others, and if the records of successes and failures were to be buried in the archives of the various departments, not only would such information, of utmost value to each city, be practically unavailable, but also the experience of all cities would be rendered useless to their neighbors. When the extremely small expense incurred in printing such information is compared with the inestimable value to be gained by every city's officials, there should be no hesitancy on the part of any city to publish in full its experience in all lines of public work.

The limits of this article will not permit a discussion of a detailed outline for each portion of a report on public works or the make-up of the tables to be presented, but enough has been said to indicate the main purpose around which the outline should be arranged and for which the report should be prepared.

[Leading consists in placing separate strips between lines of type. The type used on this page is 9-point on 10-point body. The editorials, pages 497-499, are set in 9-point on 11-point body. The first part of the Current News is set in 8-point on 9-point body, and the Contracting News in 6-point solid, i.e., there are no "leads," or separating strips between lines. In the halftone plates a screen with 133 lines to the linear inch is used.—EDITOR.]

SHAPING SUBGRADE IN FRESNO COUNTY TO FIT HEADER BOARDS

How California Is Building an $18,000,000 System of State Highways

Limited Appropriation Necessitated Many Economies—Feature of Work Is Successful Use of 4-Inch Concrete Base with Thin Bituminous Top

By AUSTIN B. FLETCHER
M. Am. Soc. C. E.; State Highway Engineer of California

CALIFORNIA has been constructing a system of State highways under a bond issue of $18,000,000 since the spring of 1912. The State highways act, which controls the operations, defines roughly the routes to be built, although considerable latitude is permitted in fixing the exact locations. To comply with the law about 1000 mi. of road must be constructed. About 1800 mi. may be called trunk roads and the remainder laterals, or roads connecting county seats with the trunk roads.

The trunk roads are sufficiently important to require paving to make them adequate at all times of the year. The laterals may, in general, be surfaced with gravels or other relatively inexpensive materials found near at hand.

REQUISITES FOR ROADS

Early in the work it was determined that the roads built should have the following principal characteristics: 1. A right of way not less than 60 ft. in width, where it is reasonably possible, and as direct between objective points as is consistently possible. 2. Gradients not exceeding 7 per cent, even in the mountainous parts of the State. 3. Curves as open as possible, and in no case of less than 50 ft. in radius. 4. As many culverts of sufficient capacity as are needed to take care of surface and underground water. 5. A traveled way, under ordinary conditions, not less than 21 ft. in width, and in the mountains not less than 16 ft. wide, with the center paved or surfaced so as to be hard and smooth under all climatic conditions at all times of the year, the width of surfacing to be in general 15 ft. 6. Smoothly graded roadsides, reserved for future tree planting.

It is obvious that an appropriation of $18,000,000 for the construction of 3000 mi. of modern highways, or at the average rate of $6,000 per mile, is a very close, if not an impossible figure. Even the engineering and administration expenses must be paid out of the $18,000,000.

It was necessary, therefore, to eliminate all possible expenses and substantial savings were effected by requesting the counties to provide rights of way for the State highways without cost to the State; requesting the counties to construct along the routes all bridges having spans in excess of 20 ft.; omitting from the system all streets in incorporated cities and towns and placing the burden of their improvement upon the corporations; securing extraordinary reductions in freight charges on road materials used in the State highway work; making contracts with supply men for materials in large quantities at reduced rates, and supplying such materials to the contractors.

The savings due to the elimination of the expenses above outlined amount to several millions of dollars, for in a most generous manner the requests of the State to the counties, incorporated cities and towns and the railroads were favorably received and granted almost invariably.

In California, as in Massachusetts, the State controls the entire width of its highways from location line to location line in all matters except policing. Thus no street railways may be constructed or power lines or telegraph or telephone lines placed except under a permit from the department of engineering, nor may the roads be dug up for water pipes or sewers without its consent. It is necessary, for this reason, if for no other, that the records of the highways be made very carefully and accurately and extraordinary pains have been taken with the surveys and plans so that there may be no doubt in the future as to the rights of way. In addition, substantial concrete monuments are set at all angle points on both sides of the right of way and at all beginnings and endings of curves and on long tangents in sufficient number to fix the lines. These features add much to the engineering cost of the project, but it is believed that the expense is amply justified.

Before beginning operations, the principle was well established in the minds of those in control of the project that the paving of the trunk line highways should be so planned and constructed as to fit the traffic needs. In other words, it would be futile to adopt a rigid standard for the pavement and install it in all localities, regardless of the local conditions. Money would inevitably be wasted under such a policy, either because of unnecessarily high first cost or, if the pavement proved to be inadequate, enormous maintenance charges.

THREE TYPES OF PAVEMENT

The problem was reduced to a choice of three types of pavement possible under the conditions obtaining in California: 1, oil-macadam pavement (penetration method); 2, concrete roadway with a relatively thin bituminous wearing surface; 3, concrete roadway with a thick bituminous top of asphaltic concrete.

It was recognized that the water-bound macadam roads would not serve on the main lines of travel because of the preponderance of motor traffic.

The brick pavement was not seriously considered as available because of the great cost of that type under California conditions. There are few, if any, suitable paving bricks made on the Pacific Slope within a reasonable haul by rail and eastern brick would be enormously expensive.

The asphaltic concrete pavement (Warrenite and its variants), unsupported by a cement concrete base, was not considered so satisfactory as with the cement base and because there is little, if any, difference in cost in California between the "black base" and the cement base.

At the beginning of the work it was thought that for the major part of the paving the oil-madacam type would have to be adopted in all cases where the traffic was moderate in volume. Oil-macadam, as it is called in the vernacular of the West, is substantially what is referred to in the East as macadam, penetration method.

The going price for Portland cement was high and the price was closely controlled by the manufacturers. Two contracts, aggregating about 20 mi., were left for oil-macadam pavements and the roads were built satisfactorily. The chances for failure in this kind of work, however, are many. It is difficult to secure suitable broken stone for this kind of work in many localities. The local gravels will not serve unless they are passed through a stone crusher and then they are often ill-adapted to the work. It is difficult to control the quantity of the asphaltic oil used and, all in all, the oil-macadam road in California, at the present writing, is not looked upon with much favor generally.

To establish a market for Portland cement for highway work, the manufacturers, after much parleying, agreed to reduce the price then obtaining and established a maximum mill price, which they agreed to protect during the life of the State highway work, thus permitting a much more general use of that commodity. Thereafter most of the highways were planned with a cement concrete base and a bituminous top, thick or thin as the character of the traffic seemed to dictate.

THIN BITUMINOUS TOP ON 4-INCH CONCRETE BASE

In most cases where the traffic is moderate in volume—500 to 600 vehicles per day, at least one-half of the vehicles being business or pleasure motors, with a fair sprinkling of wagons carrying from 5 to 8 tons of produce—the concrete base with a bituminous top from ½ to ⅜ in. thick is being constructed. Indeed, although the writer decries the use of the expression, this kind of pavement has been called the Standard type of the California State highways.

In general, where the subgrade is firm and hard and likely to stay so, or where the subgrade can be made to conform to such requirements, the concrete base is but 4 in. in thickness. There seemed to be ample precedent in the mind of the writer for a base so thin as 4 in. in certain eastern construction of which he had knowledge, and certainly if such a base is sufficient in the frost-bitten East, there would be little doubt of its adequacy in sun-kissed California. The experience of more than 2 yr. has proved the suitability of the 4-in. concrete base under the conditions mentioned. There have been no failures even under extreme traffic. The writer does not wish to be understood as favoring a base so thin except under ideal conditions of subgrade, with a total absence of frost conditions. The concrete must be honestly made and laid and reasonably rich in cement.

In the California work the concrete closely approximates a 1:2:4 mixture and it is carefully inspected in all stages. The materials are usually purchased by the State and delivered to the contractors. The cement is invariably handled in this way. When the concrete must be laid over adobe or other bad material the base is thickened to 5 or 6 in.

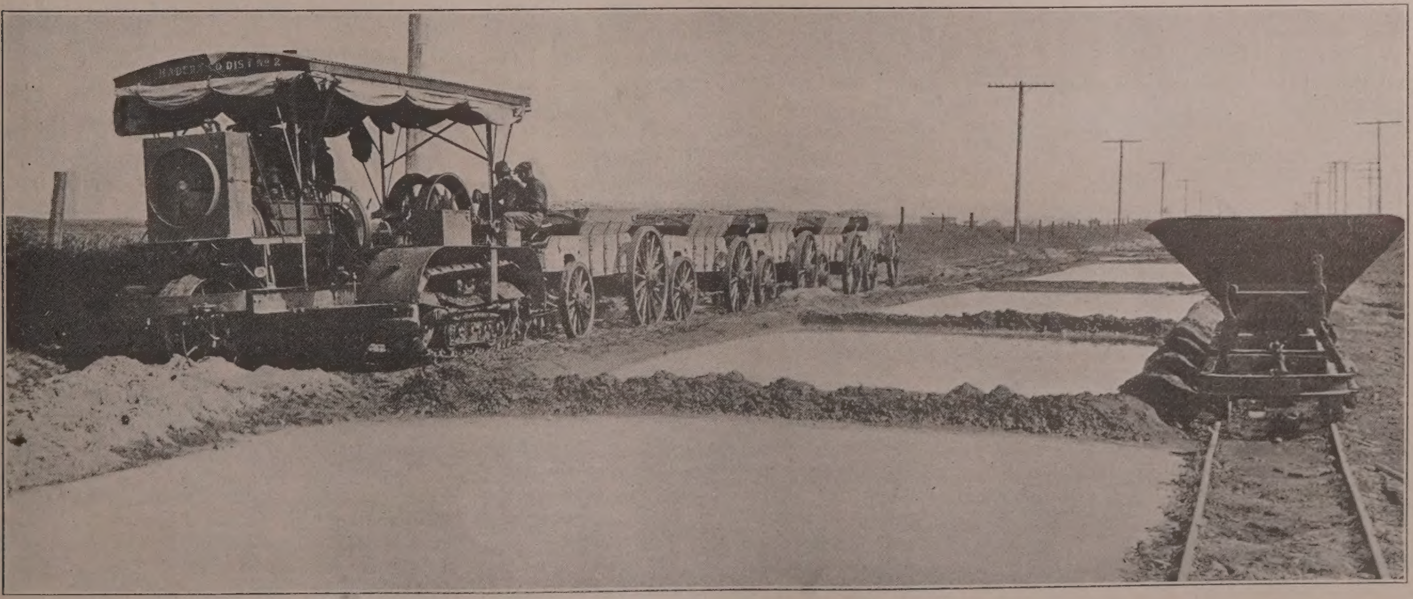
EXPANSION JOINTS OMITTED

Another somewhat unusual feature in the California work is the omission of expansion joints. All of the concrete base is covered with a wearing surface of asphalt, thick or thin. It is notorious that all concrete pavements crack, whether because of contraction, expansion or absorption of moisture. Many learned members of the profession are still seeking the reasons, for they are probably diverse, in an endeavor to minimize the cracking. It is equally notorious that concrete pavements will crack in a most perverse manner and they do not always open solely at the artificial joints. The bituminous covering, in California, seems to fill such small cracks as develop and there has been but little, if any, trouble from such cracks.

There have been cases, however, in the hot central valley, with mid-summer temperatures of 110 deg. Fahr. or more, where the concrete has buckled. The writer is familiar with one section about 10 mi. long which has sixteen buckles, due, beyond doubt, to the expansion of the concrete. It is possible that a few joints in that 10-mi. stretch, filled with asphaltic material, would have prevented the buckling. Such cases, however, are few and far between in the California work and by no means suggest the need of any radical change in policy as to the non-installation of expansion joints.

NATIVE ASPHALTIC OIL

There has been much said in California concerning the thin bituminous wearing surfaces which the State has employed so generally. The State is fortunate in having within its borders a vast supply of oil with an asphaltic base. This oil, or most of it, is so heavy in its natural state as it is pumped from the ground, that it is better adapted for making asphalt and fuel oil than it is for manufacturing kerosene and gasoline. The California asphalts, as now made, have become well and favorably known all over the United States. It is be-



METHOD OF CURING CONCRETE ROADS IN MADERA COUNTY BY BUILDING EARTH DIKES AND FLOODING WITH WATER cause of the excellence of the asphaltic oil which has been secured that the thin top has been so successful on the State highways.

The oil is purchased by the State in large quantity after competitive bidding on carefully prepared specifications. It is tested from time to time as the storage tank is filled, and it is known before shipment to the work that the oil is satisfactory. For the thin top work an oil carrying about 90 per cent of bitumen is now considered the best adapted for covering the concrete, but under certain conditions oils in excess of 95 per cent have been used successfully.

There is no essential difference between this coating and the bituminous carpets which have been used for 8 yr. or more in protecting macadam roads from the ravages of automobiles. It seems likely, however, that because of the excellent oil in California the coating will have a longer life than the bituminous carpets applied in the East.

The earliest work of this sort on the California State highways was done near Fresno about 23 months ago. There is hardly any wear appreciable at the present time on this surfacing and there is every indication now that the bituminous covering, in that locality at least, will have a life of at least 4 yr. with little or no expense for repairs.

Near San Francisco and running southerly to San Jose, about 50 mi. distant, the traffic is very great in volume and the paving has been made wider and the wearing surface thicker than is usual in the less populous regions, the paving varying from 20 to 24 ft. in width.

In some places where this stretch had been previously macadamized, the old roadway was used as a base for the new road and the asphaltic top, about 1½ in. thick, was placed upon the old macadam after considerable labor and expense in smoothing and re-rolling. It was usually found, however, that the old macadam was so worn that it cost excessively to make it suitable to receive the asphaltic top and it is probable that a cement concrete base would have been nearly as cheap and the results would certainly have been better.

In general, where the traffic is heavy, a wearing surface of 1½ in. of asphaltic concrete has been placed over an adequate cement concrete base, the top and the base being united by a paint binder of asphalt and gasoline or distillate, applied hot to the cleaned concrete base.

TABLE 1—PROGRESS TO OCTOBER 15, 1914

Item	Miles
Surveys made and plans in various stages	2000
Layouts made	1028
Contracts advertised or awaiting award	93
Contracts let, including certain day labor work, 128 contracts	891
Work completed and accepted	211
Work completed but not yet accepted	350

TABLE 2—DIFFERENT TYPES OF WORK

Type	Miles
Graded only (to be surfaced under future contracts)	237.3
Macadam (thin bituminous carpet)	7.6
Oil macadam	24.4
Cement concrete (thin bituminous top)	590.0
Macadam (thick bituminous top)	11.7
Cement concrete (thick bituminous top)	17.0
Timber and concrete trestle	3.0
	891.0

TABLE 3—COST TO STATE OF 211 MILES OF HIGHWAY

Item	
Excavation, regardless of classification	$0.44 per cu. yd.
Concrete, in structures	12.60 per cu. yd.
Concrete, in pavement bases	5.93 per cu. yd.
Asphaltic concrete wearing surfaces, 1½ in. thick	0.54 per sq. yd.
Thin bituminous tops (⅜ to ½ in. thick)	0.09 per sq. yd.

TABLE 4—SCOPE OF ORGANIZATION AND SALARIES

	Head-quarters	Divisions							Total	Monthly Av. Salary
		1	2	3	4	5	6	7		
Secretary	1	..	..	..	..	..	..	..	1	$255.00
Asst. secretary	1	..	..	..	..	..	..	..	1	140.00
Asst. highway engineers	2	..	..	..	..	..	..	..	2	250.00
Div. engineers	..	1	1	1	1	1	1	1	7	250.00
Asst. div. engrs. and prin. asst.	..	1	1	2	1	1	1	2	9	188.00
Attorney	1	..	..	..	..	..	..	..	1	250.00
Chief of right of way dept.	1	..	..	..	..	..	..	..	1	200.00
Right of way agents	..	..	..	..	2	..	..	..	2	140.00
Purchasing agent	1	..	..	..	..	..	..	..	1	175.00
Asst. purchasing agent	1	..	..	..	..	..	..	..	1	100.00
Office engineers	1	..	..	1	..	..	1	..	3	166.00
Resident engineers	..	4	5	12	14	9	5	12	61	155.50
Asst. res. engineers	..	5	7	10	46	12	8	13	101	100.00
Chief accountant	1	..	..	..	..	..	..	..	1	225.00
Clerks	5	1	1	2	2	2	1	2	16	107.00
Stenographers	7	..	..	1	2	2	1	1	14	90.00
Typist	1	..	..	..	..	..	..	..	1	75.00
Messenger	1	..	..	..	..	..	..	..	1	40.00
Geologist	1	..	..	..	..	..	..	..	1	225.00
Testing engineer	1	..	..	..	..	..	..	..	1	150.00
Helpers at laboratory	2	..	..	..	..	..	..	..	2	55.00
Draftsmen	10	5	4	11	20	12	4	15	81	105.00
Chiefs of party	..	2	3	2	3	1	1	4	16	120.00*
Instrumentmen	..	2	5	3	2	..	3	6	21	92.50*
Rodmen	..	4	5	7	3	10	8	4	41	61.00*
Chainmen	..	4	1	3	5	..	4	8	25	50.00*
Axmen	..	7	..	..	1	..	..	2	10	47.00*
Leveler	..	1	..	..	..	..	..	..	1	75.00*
Teamsters	..	..	4	..	..	..	..	1	5	50.00*
Cooks	..	1	2	..	..	..	1	2	6	55.00*
Blue-printers	2	..	..	..	..	..	..	..	2	55.00
Asphalt plant inspectors	..	..	..	..	2	..	..	1	3	120.00
Total	40	38	39	55	104	50	39	74	439	

*Receive board and travel allowance in addition to salaries.

For the asphaltic top, Warrenite, Topeka mixture and sheet asphalt have all been used, apparently with excellent results.

PROGRESS OF WORK

Table 1 indicates the progress of the work to October 15, 1914.

Table 2 is a classification of the different types of work represented in the 128 contracts referred to.

An examination of the final estimates for the 211 mi. of State highway already completed and accepted shows that the principal items of the work have cost the State approximately as shown in table 3.

ADMINISTRATION

All of the State highway activities are under the control of the department of engineering, but in every way legally possible all of the control has been delegated to the three members of the advisory board of the department, who were specially chosen by the Governor to look after State highway matters. These three men, Charles D. Blaney, of Saratoga, chairman, Newell D. Darlington, of Los Angeles, and Charles F. Stern, compose an executive committee called the California Highway Commission.

The highway engineer, appointed by the Governor, acts under the plan of organization adopted as general manager of the project, and reporting to him are the departments of engineering and operating, legal, purchasing, accounting and disbursing.

The State has been divided into seven divisions, each in charge of a division engineer, to whom the office and field men report directly.

Table 4 indicates, in a measure, the scope of the organization and the many classifications into which its employees are divided.

It was the early aim of the State officials entrusted with the construction of the State highway system of California to have the same in its entirety available for public use when the gates of the San Francisco and San Diego Expositions swing open to the world in 1915. Untoward market conditions for the sale of the State highway bonds have prevented, but visitors to California next year will find many hundreds of miles completed and the whole system sufficiently advanced as to indicate what the completed whole will be like.

Eliminating Crown on Curves

IT has been found advisable in the highway work carried on in King County, Washington, to build the curves on brick pavements without crown. The usual superelevation now being used on curves is about twice the crown prescribed for any given width, while the maximum superelevation is 1 ft. for a 20-ft. roadway.

The amount of superelevation is not determined by the length of the radius, but rather by a number of other conditions, chief among which is the width of central angle. Owing to the fact that automobiles usually "cut corners" on a short curve, they swing around it on a larger radius than the centerline actually has, so that the superelevation required on a short curve is less than that needed for one with a greater central angle. No drainage difficulties have been reported, and there is a general agreement among motorists that the elimination of crown makes the curve safer and easier to drive over at high speed.

CONCRETE BLOCKS are to be used for lining the new lake intake tunnel for the Cleveland water supply. The new tunnel is 10 ft. in diameter and 16,000 ft. long from crib 4 to crib 5 in Lake Erie. Crib 4 is located about 1⅓ mi. from shore and crib 5 about 4 mi. from shore. About 300 ft. of the tunnel have been constructed with a lining of four rings of brick. The city has recently erected a shield to be used in the construction of this work. The concrete blocks with which it is proposed to line the tunnel will be manufactured and used according to the system patented by Walter C. Parmley, of New York City. According to information received from C. F. Schulz, commissioner of water, a contract has also been made with Charles J. Carpenter and L. W. Anderson, of Grand Rapids, Mich., for the use of two tunneling machines designed and patented by them.